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Debt Capitalization: A New Perspective on Ricardian Equivalence

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Abstract

Rational individuals know that present government debts transform into higher future taxes. The Ricardian equivalence implies that the burden of the debt is not shifted between generations because of compensating intergenerational transfers. While the assumptions for Ricardian equivalence to hold are quite demanding, we argue that there exists another equivalence mechanism which works also with non-altruistic individuals: Public debts capitalize into property values. Thus, communities with larger net debts exhibit, ceteris paribus, lower property prices. We provide empirical evidence for debt capitalization using unique data for the Swiss metropolitan area of Zurich.

Key words: Capitalization, Public Debts, Ricardian Equivalence, Taxes, Local Public Goods.

JEL classification: H74, R51, H00.

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1 Introduction

Many citizens fear that debt financing of government expenditures burdens future generations. This contrasts with the Ricardian approach to public debts which starts from the presumption that debt-financed deficits result in higher future taxes that have the same present value as the initial deficits. For rational, forward-looking, and infinitely-living individuals, it is therefore equivalent whether public expenditures are financed via present taxation or debts, i.e. future taxation. Barro (1974) shows that this also holds if there are more generations than one of finitely-living individuals provided that the utility of future generations enters into the utility function of the present generation. In such a world, the present generation cannot, and does not want to, shift the burden of the public debt to future generations.

But as is commonly known, the assumptions for this kind of Ricardian equivalence to hold are quite demanding. In modern economies many individuals of the present generation often have no descendants, and migration makes it likely that the debts have to be repayed by the descendants of other parents. It could therefore be argued that the present generation has forceful incentives to amass debts in order to shift the burden of public expenditures to future generations.

However, there is another mechanism that enforces a correspondence between, and under some realistic assumptions even the equivalence of, tax and debt financing: Capitalization of jurisdictional assets and debts into property prices. The Ricardian equivalence as stated by Barro has mostly been discussed in the context of closed economies and national debts. In open economies such as small countries or local jurisdictions, however, the price of housing reflects individual preferences for packages of public services and tax prices. Capitalization occurs when, for given housing and demographic characteristics, the difference in local property values reflects differences in taxes and public services. As is well known, the quality of government services and the level of taxation indeed capitalize to a large extent.[1] There is no reason why debts should not also capitalize.

[1] Among others Oates (1969), Oates (1973), Pollakowski (1973), Edel and Sclar (1974), Chinloy (1978), Reinhard (1981), Yinger, Bloom, Börsch-Supan, and Ladd (1988), Brasington (2002), Reback (2005) consider the capitalization of taxes and/or public goods.

Intuitively, the mechanism works as follows: The demand for property depends on the utility of the inhabitants which depends itself on the quality of public services and the tax price. These two variables depend, in turn, on the debt burden. Rational individuals form expectations on the future development of real estate values. If the present generation expects future house prices to rise due to, among other factors, high net assets or low net debts, individuals already bid more for houses today causing present prices to rise. On the other hand, communities with negative prospects due to high net debts will see declining house prices even today. Therefore, it is not the future generation who bears the burden of government debts but present property owners. Consequently, we expect property prices to be lower in communities with lower net assets and higher net debts, respectively.

In fact, we (see e.g. Eichenberger 2007, Stadelmann and Eichenberger 2008) are not the first to formulate this idea. Daly (1969) has pinpointed it already long ago. But capitalization of public debts has played no role in the literature since then and has only be rediscovered recently (see Banzhaf and Oates 2008).

Note that our approach and Barro's theory do not exclude each other but are complementary. For small jurisdictions, however, our approach relies on less demanding behavioral assumptions. Moreover, according to Barro (1989) empirical studies do not provide consistent support for his theory. He attributes this to identification problems and the simultaneity between consumption and income. In contrast, we argue that our approach suffers much less from these problems as endogeneity problems are usually less pronounced when the dependent variables are housing prices.[2]

To test our theory we analyze the prices of standardized single family houses for the 171 communities of the Swiss Canton of Zurich using a panel model for the years 1998 to 2004. Swiss municipalities form a particularly good fiscal laboratory for our purposes for at least four reasons: (1) they have a high autonomy level with respect to local income

[2]In the first capitalization study Oates (1969) still discusses the problem of possible endogeneity of property taxes and housing prices. The results of numerous studies differ little when comparing OLS and IV estimates. Experimental studies find similar price impacts of diverse variables with respect to signs and often also sizes (see for example Black 1999 or Chay and Greenstone 2005). Thus, most recent articles on capitalization of other variables than debts do not focus on endogeneity problems (see for example Stull and Stull 1991, Palmon and Smith 1998, Brasington 2001 or Brasington 2002). Bajari and Kahn (2005) call this a common practice in the hedonic literature.

taxation and financing decisions; (2) they use a common harmonized public accounting system for budgeting, bookkeeping with balance sheets, and reporting which facilitates comparisons of fiscal variables; (3) they have free access to capital markets; (4) and the Swiss federal court prohibits higher government levels from bailing out municipalities.

Municipal real net funds as the difference between financial assets minus liabilities and municipal equity are commonly used indicators in government publications.[3] We show that municipal net funds and municipal equity capitalize positively. Several specification tests for a number of different measures of communal wealth lead to the same conclusions. The effects found are not only statistically significant, but also economically highly relevant, thus bolstering the capitalization based theory of equivalence of debt and tax financing for the local public sector.[4] Thus, the political fight over deficits and debts is no intergenerational conflict but an intragenerational conflict between today's property owners and today's tenants.

We are aware that in real life the capitalization mechanism is affected by various identifiable conditions. Two types of such conditions may be discerned. The first group comprises conditions such as housing market inefficiencies due to moving costs, slow adjustment mechanisms, and fiscal illusion as proposed by Buchanan (1964). Under such conditions capitalization still holds in the long run but is slow and more erratic in the short run. Thus, if a short run increase of debt spending occurs, there are losers and winners who have incentives to lobby for and against debt spending, respectively. Second, there are mechanisms such as fiscal equalization schemes that explicitly or implicitly transfer the debt obligations from one community to others or to higher government levels. These mechanisms weaken capitalization at the local level but transfer it to another level, thus offering the local jurisdictions incentives to go for debts.

The remainder of this paper is structured as follows: Section 2 marries two branches of the literature. First, we present Barro's equivalence and briefly comment on the proposed mechanism for national debts. Moreover, we discuss the related literature on

[3]The Statistical Office of the Canton of Zürich writes in its press release statistik.info 21/2003 that the most important financial indicator of the balance sheet are „net funds" (translated from German).

[4]We calculate partial capitalization rates for our independent variables municipal real net funds and equity. For real net funds capitalization rates are between 40 and 80 percent and for equity full capitalization cannot be rejected.

capitalization of taxes and public goods as well as studies that analyze the problem of underfunding of local pension funds. In Section 3 we propose additional explanations for capitalization as a channel, leading to the equivalence of taxes and debts. The insights are then brought to the data and we perform a number of robustness tests and discuss possible upward biases of our coefficient estimates for the capitalization of a community's debts. Section 4 summarizes our results and concludes.

2 Related Literature

The traditional view of government debts presumes that when governments cut taxes and run deficits consumers increase their spending as disposable incomes increase. Barro (1974) considers an alternative view of government budget deficits. For a given path of government spending, today's deficits are equivalent to future taxes. Hence, a cut in today's taxes must be matched by an increase in the present value of future taxes. In an overlapping generations model where households act as though they lived infinitely, government debts have no effect on consumption as (altruistic) individuals increase their savings in order to allow the future generation to pay back the debts. Therefore, a tax cut financed by new government debts does not reduce the tax burden for the present generation, it simply reschedules it. It is important to note that Barro's results are generated by the infinite time horizon of his individuals. A member of a specific generation is assumed to be concerned with his own consumption and with the utility of his descendant who in turn is also concerned with his own consumption as well as the utility of his descendant, ad infinitum. This form of utility function implies intergenerationally dependent preferences and effectively creates an infinite time horizon although each individual member of a generation has only a finite lifetime. In order to establish the equivalence of taxes and public debts, loan markets must be perfect, individuals must be certain about their future income, and taxation must not be distortive. However, market imperfections do not anihilate but only weaken the correspondence between taxes and budget deficits.

This view on budget deficits was labeled by Buchanan (1976) and others as well as

by Barro (1989) himself as the „Ricardian equivalence". Indeed, Ricardo remarks that the issuance of debts brings about a temporal redistribution of payments. The incidence, though, does not change. Ricardo writes: "When, for the expenses of a year's of war, twenty millions are raised by means of loan, it is the twenty millions which are withdrawn from the productive capital of the nation. [...] Government might at once have required the twenty millions in the shape of taxes; [...] This, however, would not have changed the nature of the transaction."[5]

In the past decades, persistent budget deficits and increasing debts have aroused interest in the Ricardian equivalence. Barro (1989) discusses major empirical and theoretical objections that have been brought forward against his conclusions. The empirical results are inconclusive which can be attributed to the general identification problems and endogeneity issues. The main theoretical objections aim at the assumption of interdependent utility functions and intergenerational transfers, which actually generate the infinite time horizons and, thus, equivalence.

While the Ricardian equivalence is dependent on specific assumptions which might or might not hold, there is another mechanism which leads to a correspondence between taxes and public debts. It works through the housing and land market. By issuing bonds and accumulating debts, a community is only able to alter the time distribution of explicit tax payments. Sometime the outstanding debt has to be paid back. If the issuing generation wants to sell its property it faces lower values when large obligations were accumulated in the past. The buying generation bids less for the assets as they have to pay back the accumulated debts through higher taxes in the future. Debts therefore reduce the price for the current generations' houses and they have to bear the burden. While this argument is surprising to many economists and is not mentioned in the academic and public debates on debts and deficits, it has already been brought forward by Daly (1969).

In the same year Oates (1969) argues in a path-breaking study that consumers migrate to the jurisdiction offering the tax/public services packages which is the best suit-

[5] See On the Principles of Political Economy and Taxations, The Works and Correspondence of David Ricardo on pages 244-245.

able to their preferences. Differences in these fiscal packages are then reflected in the price of housing services that individuals are willing to pay to live at a certain location, providing a test for the Tiebout (1956) hypothesis. Oates' regressions confirm capitalization of both property taxes and public goods which are approximated by public expenditures. Following Oates, a number of well known papers in public finance defend a completely opposite vision, regarding the question of an empirical test for the Tiebout model. Starting with a critical comment from Pollakowski (1973) and an immediate reply in Oates (1973), authors like Edel and Sclar (1974) and Hamilton (1976 AER, 1976 JPE) argue against capitalization of fiscal variables such as taxes, expenditures or public services into housing prices. Brueckner (1979) provides an excellent insight into this scientific discussion. Starrett (1981) and Yinger (1982) finally conclude the intellectual debate after more than a decade by providing theoretical models that validate the capitalization of fiscal differences in the long run.[6]

A large volume of empirical literature followed the first capitalization studies mainly differing in the degrees found for capitalization of diverse variables and the hypotheses tested. The literature finds that apart from differentials in taxes and public services, school quality, environmental quality, neighborhood characteristics etc. are partly or fully capitalized into property values. A comprehensive study for capitalization was done by Yinger, Bloom, Börsch-Supan, and Ladd (1988). Other and more recent capitalization analyses include Stull and Stull (1991), Palmon and Smith (1998), Epple and Sieg (1999) and Brasington (2002) among others. Property values have also been used as a proxy for the valuation of public goods. Black (1999), Figlio and Lucas (2004) or Reback (2005) are some of the numerous examples. Fischel (2001) argues that property owners as watchful citizens of local governments counteract possible risks to their assets.[7] Interestingly, none of all these capitalization studies looks at the capitalization of public debts. Nevertheless, there exists some related literature. There are some few papers which analyze the effects

[6]For our paper the link between capitalization and the Tiebout hypothesis is of little importance. We deal with the capitalization of municipal real net funds and equity in order to establish an equivalence between taxes and local public debts that operates through capitalization which exists in the long run. For a test of pareto-efficiency in public good provision see Brueckner (1982) and Deller (1990) who extends the approach.

[7]As the number of potential capitalization factors is high Stadelmann (2007) considers a large set of variables in an empirical „Horse Race“ using Bayesian Model Averaging.

of unfunded liabilities of pension plans of municipal governments.[8] Epple and Schipper (1981) emphasizes the problem of finding good measures for the local underfunding problem of pensions as actuarial assumptions vary between different jurisdictions making it difficult to estimate the precise obligations. While they find some capitalization effects for municipalities in the Pittsburgh area, their results do not imply full capitalization and they mention that additional empirical research on the question is needed. In a similar setting, Leeds (1985) considers 67 cities in the Chicago area. As a measure for unfunded liabilities he uses the ratio of the payments by the pension fund to the assets held by it. He does not find any significant coefficients in the regression analysis for his underfunding measure but suggests that underfunded pensions have an indirect effect on property values via taxes. Actions of previous political generations affect current taxes and thereby house prices. Consequently, underfunding is a form of hidden taxation and politically motivated. Both contributions partly attribute their moderately significant results to the difficult data situation and weak municipal accounting systems. The authors state that the evidence for the capitalization of unfunded liabilities is inconsistent and further empirical research might shed light on the underlying mechanisms.

3 Capitalization of Debts

The mechanism of debt capitalization can easily be understood by looking at individuals' demand for property. In order to consume the local public services and amenities, individuals have to own or rent property. Thus, they have to decide in which community they settle, i.e. where to buy or rent property. Their willingness to pay depends on the relative benefits (i.e. local public services and amenities) and cost (i.e. taxes). Public debts are relevant to the individual's demand for property as they involve opportunity cost. Public resources have to be spent for interest payments and repayment of the debt, but cannot be spent in order to increase government services or to reduce taxation. Therefore, an increase of debts leads either to reduced future public services or to

[8] In a comprehinseve literature research we found two contributions only. Generally, it is difficult to find studies on capitalization of certain variables as authors do not usually consider them as capitalization analysis but as mainly relevant in their specific field.

increased future taxation.

The extent of debt capitalization depends as for taxes and other variables on the elasticity of supply of land for construction and the institutional mechanism which determines zoning.

If there is a competitive market for the size of the residential area, capitalization of debts depends on the price elasticity of supply of residential area. For each jurisdiction the maximum capacity for residential areas is fixed. Consequently, nonresidential land cannot be converted endlessly, and the supply of housing must become inelastic when approaching full capacity. The rising costs of land conversion imply that the reaction of land developers to fiscal differences by supplying additional housing ceases once all profitable conversion has occured. Moreover, land developpers do not only react to differences in fiscal variables but also to differences in amenities which are an additional source of heterogeneity and variation. In long-run equilibrium, for a sufficiently high population density, such as in a metropolitan area, no more conversions are possible and local fiscal variables will be fully capitalized. Then the effect of changes in tax/public service combinations and amenities on house prices is driven by demand alone which results in full capitalization.

Edel and Sclar (1974) and Hamilton (1976 AER, 1976 JPE) argue against the capitalization of fiscal variables such as taxes, expenditures or public services into housing prices because they expect the supply of land to react. They have claimed that in a fully adjusted Tiebout equilibrium local taxes are pure benefit taxes, that is, they are considered by households as a price for public goods and there should be no relation to the housing's market price. According to these authors the supply of jurisdictions can be increased in the very long run. Therefore, the supply of any arbitrary tax/public service combination is perfectly elastic. In this case competition equalizes differentials in house values.[9] Still, the supply of tax/public service combinations cannot be perfectly elastic as it is linked with opportunity costs for land developpers and juristictions are often

[9]Epple, Zelenitz, and Visscher (1978) and Epple and Zelenitz (1981) mention that a test of capitalization and a test of the Tiebout hypothesis are not the same. A test for capitalization is feasible when residents are informed about fiscal characteristics in alternative jurisdictions and government restrictions do not cause individuals to consume more housing than they would in the absence of such restrictions.

unique as far as different amenities are concerned. Yinger (1981, 1982) brings forward similar arguments against the case of Edel and Sclar (1974) and Hamilton (1976 AER, 1976 JPE) by discussing specifically the influence of higher commuting costs for households at the urban edge. He concludes that only if jurisdiction boundaries were flexible and fiscal zoning was used, juristictions with desirable tax/public service packages could devour others and differentials would vanish. This seems a rather unrealistic case as a juristiction's size does not usually change because of rent differentials and such changes depend on strong political will.

Moreover, housing prices are not only influenced by fiscal variables but also by additional factors such as amenities. Housing prices decline, for example, with higher air pollution, greater distance to the center or worse exposition. If developers have to build houses in industrial areas, further away from the center, or at windward sides of mountains their profits decline even though taxes might be low and public services are provided efficiently. Additionally, tax revenue does not necessarily translate in the same direct way into public services for all communities as supposed by the above mentionned authors.

Clearly, the elasticity of supply is an empirical question and depends on various factors. While it is obvious that in some regions in the United States there is ample land which can be developed, it is also evident that in more densely populated regions the elasticity of supply is almost nill. In Switzerland, for instance, the area which can be used for construction of buildings has only increased by about 2.7 percent in total between 1994 and 2006, and in the Canton of Zurich area available for housing has actually decreased over the same period.

However, the discussion on the elasticity of land supply is not necessarily important for the capitalization of debts: Under the assumption that local governments maximize land rents, debts do not affect zoning decisions if property demand is linear. Thus, there is a fundamental difference between the capitalization of local public debts and local public goods or bads. The effect of normal public goods on the demand for land is independent of the amount of land used for construction. Therefore, an increase in the supply of public goods leads to a shift in demand for land which gives the government

incentives to rezone land for construction use. In contrast, the effect of public debts on the demand for land depends on the amount of land available for construction use as the debt burden can be distributed between property owners. With a given amount of debts the burden per unit of property is decreasing when the amount of land is increased. Consequently, when debts are increasing, government faces two opposing incentives: On the one hand, demand for property decreases which induces government to reduce the amount of land available for construction use. On the other hand, government has incentives to increase the amount of land in order to distribute the debt burden among more property owners. Normally, these two effects cancel each other.[10]

The issuance of debts does not change their incidence, as already proposed by Ricardo referring to a different mechanism. Correct foresight of debt induced future tax obligation translates into lower house prices today. Current bad management of local finances is a problem of the current generation of house owners but not of the future ones. To pinpoint the economic intuition, consider a community that does not care for the future generation. They decide that the jurisdiction indebts itself and redistributes all the money via a lumpsum subsity to the current citizens for consumption. When all communal reserves are depleted and banks do not grant any more loans, they decide to move away and sell their property to some future inhabitants. All the accumulated liabilities *do not* represent a burden to the future generation. Property persists over time. If the houses change hands through a free market, as can be assumed, the low market price for homes will fully compensate the future inhabitants for the debts they have to repay. The bids of the buying generation are lower because of the higher tax schedule they have to face. The reduction in lifetime income, or the burden, remains with the current generation, i.e. the generation that issued the municipal debts because they can only sell their property at a low value. This establishes the propsed equivalence of taxes and municipal net wealth through the capitalization channel.

[10] In order to maximize land rents, government has to equate marginal revenue and marginal cost of rezoning land. Marginal revenue is dependent on demand for land, x. If demand is linear of the form $p = a - bx$, the demand with debts, D, becomes $p = a - bx - \frac{D}{x}$, as the debt burden is distributed between property owners. The marginal revenue of rezoning then is $(px)' = (ax - bx^2 - D)' = a - 2bx$, which is obviously not dependent on debts.

3.1 Data and Characteristics of Swiss Communities

For the purpose of evaluating the equivalence of taxes and public debts empirically, we use a panel dataset of municipalities from 1998 to 2004 in the metropolitan area of Zurich, Switzerland.

The Canton of Zurich is the largest of all 26 Swiss cantons and has approximately 1.3 million inhabitants. The city of Zurich is the center of the largest urban agglomeration in Switzerland with over one million people living and working there. The metropolitan area consists of 171 municipalities (including the city of Zurich and the city of Winterthur). Heterogeneity is driven by, among other factors, the widely differing size of the communities (from 251 to 29321 inhabitants, excluding Zurich and Winterthur), their distance to the economic centers, and their exposition towards the Zurichsee, a 88.66 km2 large lake in the canton.[11]

The tax system of the Canton of Zurich is typical for Switzerland. Each municipality raises its own income taxes by anually fixing a municipal tax multiplier on the state tax („allgemeine Staatssteuer"), which is a progressive income tax schedule at the cantonal level. Municipal tax multipliers are set either by the citizens in a town meeting or by the municipal parliament. Thus, municipal income tax multipliers differ to a large extent among the 171 communities in the metropolitan area. According to international standards, the municipalities have also a large autonomy with respect to public expenditures and local regulations, although the cantonal as well as the federal governments set minimum standards for the provision of various public goods. In the field of environmental policy, for instance, the federal government systematically issues legal rules for the preservation of the ecosystem. On the local level these rules usually affect water resources, sewage treatment, garbage collection, air control measures etc. Minimum standards reduce the problem of errors in the measurement and the comparison of public goods between jurisdictions, that is inherent in most capitalization studies according to Palmon and Smith (1998).

In 1982 the canton's municipalities introduced a harmonized public accounting sys-

[11] Supplementary information are available in the Statistisches Jahrbuch des Kantons Zürich 2007, 17th edition, Statistisches Amt des Kantons Zürich, Zurich.

tem for budgeting and bookkeeping. These standards require all communities to follow the same legal framework concerning their current and capital accounts. In addition, they demand an annual financial statement and a balance sheet in which assets are included at acquisition value minus amortization. The balance sheet as well as other bookkeeping standards distinguish the Swiss communal finance framework from most other countries (see Oster 2006). The harmonized public accounting system is based on a functional division, each representing local responsibilities. Communal properties and funds can either be of administrative or financial nature. Public law applies to administrative assets which are usually used for the provision of local public goods and services. For the management of financial assets private law applies. Financial assets typically include shares, participation certificates and real estate holdings such as farms and forests, factories or commercial buildings. Swiss communes have full autonomy from higher government levels in domains such as the acquisition, the use or the disposition of these assets.[12] The Swiss harmonized public accounting system is supposed to have rendered services beyond its original expectations.[13]

As opposed to municipalities in countries such as Germany and Austria, Swiss communities can become insolvent when they accumulate too high debts. Most importantly, the Swiss federal court prevented higher government levels from bailing out insolvent communities in the publicly well known court case of the municipality Leukerbad, a community in the Canton of Valais with approximately 2000 inhabitants. After Leukerbad went bankrupt with obligations mounting to 346 million Swiss francs (approximately 313 million US dollars) a number of creditors were issuing lawsuits against the canton to settle the community's obligations. The federal court rejected all of them, arguing that Swiss communities act on their own responsibility.[14] Consequently, communities in our dataset do not have a strategic incentive to accumulate debts or budget deficits. They will not be bailed out by higher government levels. An additional brake against

[12] Municipalities associate local self-rule in asset management with autonomy which makes it almost a holy issue.

[13] For a detailed discussion concerning communal real property management in Switzerland as well as the harmonized public accounting system see Dafflon (2006).

[14] See verdicts of the Swiss federal court of July 3, 2003 in proceedings 2C.4/1999 (Central Agency for the Issue of Securities for Swiss Communities), 2C.1/2001 (Cantonal Bank of Basel), 2C.4/2000 (community of Leukerbad) against the canton of Valais. Further information on http://www.bger.ch/

debts and for a responsible asset management are local direct democratic institutions that allow citizens to actively participate in communal decisions as well as effective and independent communal auditing institutions (see Eichenberger and Schelker 2007).

Finally, data from 1994 to 2006 shows that total developed sites available in the canton increased only very slightly from hectare 27762 to 28511 hectares and land available for housing actually decreased during the same period from 14642 to 14040 hectares. On the other hand, cantonal population increased by over 10000 persons a year or 0.8 percent annually. This indicates that supply of land is likely to be close to its long run equilibrium and housing values mainly reflect tax/service combinations.

As a result, the metropolitan area of Zurich is a perfect laboratory in order to identify the impact of local assets and debts on private properties as implied by our theoretic reasoning. Our dataset includes a large number of variables which capture real estate specific aspects, taxes, real net funds, equity, public goods as well as different demographic characteristics.

We analyze the impact of municipal net funds and equity on the price of standardized single family houses. These houses are characterized by five rooms, two bath rooms, 450 m2 surface, 750 m3 volume, end-terrace houses, conveniently situated in the municipality, and one garage space. Standardized house prices are available for every municipality over the years 1998 to 2004. The data was obtained from the Cantonal Bank of Zurich, the largest real estate bank in the canton, which evaluates houses by the sales comparison approach based on actual transactions. Moreover, location specific characteristics such as distance to the next school the next shopping facility are available for each observation. By looking at a comparable house for each municipality we can focus on differentials between communities.[15]

Data for the independent variables were obtained from the Statistical Office of the Canton of Zurich (Statistisches Amt des Kantons Zürich), the Secretary for Education of the Canton of Zurich (Bildungsdirektion des Kantons Zürich), and the Financial Sta-

[15] Capitalization studies such as Stull and Stull (1991), Palmon and Smith (1998) or Brasington (2001) look at heterogeneous houses and consequently control for housing characteristics such as the age of the house, number of rooms, the size of the house etc. Studies such as Ketkar (1992) or Reback (2005) use the median or average value of a house in a district. Estimation of community characteristics with comparable houses improves comparability and robustness.

tistics of the Canton of Zurich (GEFIS Finanzstatistik des Kantons Zürich). For our primary variable of interest we use real net funds which are the main municipal financial assets (liquidities, assets and equipment excluding accruals) minus debts (regular obligations, short-term debts and long-term debts excluding deferrals and provisions). Moreover, we approximate a community's asset and debt situation by looking at its equity per capita from the balance sheets.[16] For robustness tests we use three different measures reported by the Statistical Office: net funds (including accruals, deferrals and provisions), self-financing per capita which is a measure similar to the managerial Cash Flow, and finally a theoretical indicator for debt repayment duration, i.e. debts divided by tax revenue. Public goods are accounted for by the average class size in primary schools, distance to schools, an identifier whether the school is managed by the community itself or a separate school community, the fraction of the elderly, the unemployment rate and the fraction of foreigners. Furthermore, we use aggregate expenditures for culture, health and social well-being as additional controls for the supply of public goods[17] and we have data on the communities' median incomes, share of commuters as well as population densities. Needless to say, we take account of local real estate characteristics by including lake view, distance to the center, environmental damage and south-west exposition.

Our dataset contains these variables for all municipalities in the canton. In the analysis we do not include the city of Zurich and Winterthur because as opposed to the other municipalities they are considered as cities and have a different structure: Zurich and Winterthur have each a number of separate districts which form the cities. These districts differ in important aspects such as median incomes, unemployment rates, the fraction of foreigners and thus, house prices, although they have the same tax multiplier

[16] This measure might suffer from evaluation standards concerning the municipal's administrative capital. It is likely to be biased downward. Financial transfers from the canton depend on a constructed index of financial power which also considers the municipal's equity. As a result, communities have an incentive to report lower equity values per capita. This incentive is though systematic for all municipalities which is an indication that a potential bias is symmetric for all communities. Furthermore the downward bias of municipal equity serves as a conservative test for our hypothesis.

[17] Because of the special school structure with separate school communities we do not have a reliable measure for school expenditures and cannot directly inculde them. Anyhow, we control for class size and for school communities.

and benefit from the same public expenditures. Consequently, the effect of diverse fiscal variables cannot be measured for each district. Furthermore, Zurich is the center of the canton and we would like to control for the distance to the center in order to treat mobility issues in our analysis.[18] Finally, the two cities are large with respect the rest of the municipalities in the canton.[19]

All control variables, their sources, and a number of unweighted descriptive statistics are given in Table 1.

< Table 1 here >

3.2 Baseline Results

The received empirical literature usually applied so called amenity models in order to estimate the impact of diverse variables on house prices (see for example Oates 1969 and the reactions to his paper, Stull and Stull 1991 or Brasington 1999). In such models the measures of interest, municipal real net funds and equity can be injected as additional variables besides common attributes including the income tax multiplier, public goods and house location characteristics.[20] Thus, we use an amenity model of the following common specification form

$$\begin{aligned}\pi_{it} &= \beta_0 + \beta_1(\text{asset/debt situation})_{it} + \beta_2(\text{TaxMultiplier})_{it} + \\ &\quad + \sum_{j=3}^{g} \beta_j(\text{PublicGoods})_{it} + \sum_{j=g+1}^{a} \beta_j(\text{other amenities})_{it} + \varepsilon_{it},\end{aligned}$$

where π_{it} represents the value of the property in each jurisdiction i at time t. The coefficients β_j for $j = 3, ..., g$ measure the impact of public goods and the coefficents β_j

[18] We performed a number of robustness tests including the city of Zurich and Winterthur. Our main insights do not change when we include these additional observations.

[19] Polinsky and Shavel (1976) show that using cross-section regressions to analyze the effect of amenities on house values is valid when the communities are considered "small" and there is mobility within and among them. The City of Zurich and Winterthur had an average number of 337262 inhabitants and 89757 inhabitants over the years 1998 to 2004. Whereas the average number for the other 169 municipalities were approximately 4700 inhabitants. The reduced samle of communities studied here is likely to approximate these theoretical conditions well.

[20] So called capitalization models would represent another empirical modeling choice which is convenient if the main variable of interest are property tax rates and the exact size of capitalization coefficient matters.

for $j = g+1, ..., a$ capture the effect of other amenities such as demographic and location effects. The estimated coefficients of the municipals' real net funds, equity and the tax multipliers represent each the ceteris paribus impact of a change in a community's wealth as well as its annual income tax multiplier.

Figure 1 represents the central motivation for this paper. It is a scatterplot for the variables real net funds, municipal equity and income tax multipliers with house prices. All values are averaged over the period of the analysis, from 1998 to 2004. The Box-Whiskers-Plots next to the horizontal and vertical axes give an idea of the distribution of the variables. The box represents the first to the third quartile of the distribution containing the median. The whiskers extend to the most extreme data point which is no more than 1.5 times the interquartile range from the box. The dashed line represents the linear relationship between the variables. In order to take account of possible non-linearities we estimate a LOESS smoother (Local Polynomial Regression Fitting) with a smoother span of 0.75 which is represented by the solid line.

< Figure 1 here >

Municipal real net funds as well as equity per capita show a significant and positive correlation with house values. On the other hand, local tax multipliers are highly negatively correlated with house values. The LOESS smoother indicates that the relationship between real net funds and house prices is almost perfectly linear. The same holds for municipal equity and house prices. The distribution of the income tax multiplier is shifted to the right with a number of outliers at the lower end.

Clearly, the correlations of Figure 1 could be a pure artifact of omitted variable bias. Therefore, we analyze the relationship between real net funds, municpal equity and house values with the proposed amenity model. Table 2 shows the results for six specifications differing in the number of included amenities and controls. Next to the significant coefficients of the panel data pooling and within regressions we estimated the impact of a one percent increase in the mean of the respective independent variable on the dependent variable.

< Table 2 here >

According to capitalization theory we expect the following signs for the independent variables: The coefficient of the aggregate spending for culture, health and social security should be positive as expenditures are a crude measure for the provision of public goods. Class size in primary schools is expected to be negative as it is an indicator for the quality of schooling. Average distance to the next school should have a negative sign too as it is more attractive to live nearer to schools. The impact on house prices of having the school included in the political community (indicator variable is one) or having a separate school community (indicator variable is zero) can be positive or negative. Separate school communities might work more efficiently (see Frey and Eichenberger 2002). On the other hand additional bureaucratic overload might lead to problems. For lake view and south-west exposition we unanimously anticipate positive coefficients whereas for the distance to the metropolitan center and the air pollution level negative coefficients should be observed. Population density should have a positive impact, as it is a measure for urbanization. Land values are known to be lower in agricultural communities. On the other hand, the fraction of commuters should capitalize negatively because commuting imposes costs on individuals. We expect the fraction of people aged over 65 to have a positive impact on house prices. The reason for our expectiation is the fact that in the Canton of Zurich mainly the elderly own property. The higher the fraction of homeowners in a community the higher the property values according to Rohe and Stewart (1996), controlling for median income which we suppose to have a large positive effect. Clearly the unemployment rate should be negatively correlated with house values. With respect to the fraction of foreigners the total effect is unclear as Zurich benefits from a large number of highly educated expatriates who might be willing to pay high rents due to high search costs.

From our model it follows that real net funds and municipal equity should capitalize positively while income tax multipliers should exhibit a negative sign. Regression (1) supports this view. The effect of municipal real net funds per capita is positive and significant at the 10-%-level whereas income taxes capitalizes negatively and significantly at the 1-%-level. The impact of a one percent change of real net funds on housing prices is 32.22 Swiss francs and a one percent increase in the mean municipal tax multiplier

reduces house values by 1073.84 Swiss francs.[21] However, we are not only interested in whether capitalization of public debts is statistically significant, but also in the extent of capitalization. Concerning the effect of real net funds, recall from Table 1 that the mean of this variable represents 2767 Swiss francs per capita. Unfortunately, we cannot directly evaluate the size of the effects found as our data for debts are on a per capita basis while debt capitalization is on a per house basis. Thus, the extent of capitalization depends on two main factors: The average number of inhabitants per house and the share of the debt burden which has to be shouldered by house owners, which in turn depends on other variables such as, among others, the share of capital taxes, the relative income of the house owners, and the progressivity of the income tax schedule. As we have no exact data on all relevant variables we can only provide a very rough estimate. Starting from the fact that in the Canton of Zurich natural persons pay about 80 percent of the taxes, and assuming that each house is inhabited by three persons[22] and that these individuals are average tax payers, we come up to a capitalization rate of 48.5 percent. We perform a hypothesis test for full capitalization which tests whether the coefficient of the variable real net funds is significantly different from a theoretical coefficient value which would generate an impact of 66.40 Swiss francs. The p-value of the hypothesis test indicates that full capitalization can be rejected.[23] Our control variables for public goods have the expected sign though the effect of class size on house values is insignificant as is the effect of the school community structure variable. As expected, the distance to the next school capitalizes negatively as does the fraction of commuters. On the other hand, population density has a positive impact. Finally, all local real estate specific characteristics have the expected sign.

Specification (2) looks at the effect of municipal equity per capita on house prices as another measure for a community's asset and debt situation. Higher municipal equity increases house values significantly at the 1-%-level. Under the same assumptions as

[21] Recall that the average tax multiplier is 113.9.

[22] For the year 2000 there have been 600503 dwelling places in the whole canton and 1206708 registered inhabitants. Instead of fixing two persons per single family houses we use the conservative estimate of three persons to calculate capitalization rates of our asset and debt measures.

[23] We shall discuss the problem of possible upward bias of the capitalization rates for real net funds in the next section. Full capitalization or even overcapitalization is not an uncommon phenomenon in the literature as contributions by Oates (1973), Church (1974) and Reinhard (1981) show.

above, the estimated capitalization rate is 101.1 percent and the capitalization tests indicates that full capitalization cannot be rejected at a significant level. All control variables have the same signs and almost the same impacts as in specification (1).

In the first two regressions we have not included year fixed effects but estimated a pure pooling model. In all further specifications we shall estimate models with year specific effects, consequently performing a conservative test of our hypotheses. The results remain almost the same in specifications (3) and (4). The signs of the variables do not change and our measures of interest remain significant at the 10-%-level and the 1-%-level respectively. The impacts of real net funds and muncipal equity decrease slightly as does the impact of tax multipliers on housing prices in absolute terms. The capitalization rate for real net funds is 44.1 percent and full capitalization can be rejected. For municipal equity the capitalization rate is 87.8 percent and full capitalization cannot rejected.

In specification (5) and (6) we include an array of additional controls. As supposed the fraction of the elderly has a positive and significant effect on property values. The unemployment rate capitalizes negatively. For the fraction of foreigners, there is a positive capitalization effect which is probably due to the large number of highly skilled expatriates working in Zurich. The variable for real net funds remains positive. Its significance level increases to the 1-%-level and its impact is 48.02 Swiss frances. Consequently, the estimated capitalization rate increases to almost 75 percent and full capitalization of real net funds is no longer rejected. For municipal equity the changes are minor. The variable remains significant at the 1-%-level and its impact is approximately 90 Swiss francs. Full capitalization for equity cannot be rejected at ordinary significance levels. In contrast, the introduction of additional controls decreases the impact of the tax multiplier and aggregated expenditures indicating that some elements of public goods are captured by the newly included variables.

So far we have shown that municipal real net funds and equity affect property values positively which provides support for the capitalization mechanism of local public assets and debts leading to the equivalence of taxes and debts at the local level. We will analyze this relationship more closely by providing robustness tests, considering different forms

of the specification and more indirect measures of municipal wealth.

3.3 Robustness Tests

First, we investigate the effect of variations of the estimation equation. Table 3 gives a number of robustness tests for the specification with the largest possible array of independent variables.

< Table 3 here >

Specifications (1) and (2) show the results when estimating a semi-logarithmic form of the amenity model (see, for example, Brasington 2002 or Brasington 2001). In such a setting the dependent variable is expressed in logs and all other variables enter the regression as in the standard setting. The results show that our main variables of interest, i.e. real net funds and municipal equity, are both positive and significant.

In specification (3) and (4) we estimate a full logarithmic form expressing the dependent variable and all other monetary variables (including the tax multiplier) in logarithms. As real net funds can be negative, we have to reconstruct the variable when taking the logarithm. Therefore, we augment all values of this variable by the maximum of all observations. Again we find support for debt capitalization. The coefficients for real net funds and equity are positive and statistically significant. In the logarithmic form for municipal equity the variabe has a positive and significant effect.

Finally, specification (5) and (6) show the results of weighted least squares models. We use log(population) as weights. The idea is that small communities might have systematically different real net funds and equity because of better direct democratic control. Our results might consequently be driven by a subsample of the data. Contrary to this reservation, the respective coefficients increase when compared to regression (5) and (6) of Table 2. Moreover, weighting does not change the positive and significant effect of neither real net funds nor of equity. There is no indication that our results for real net funds and equity are an artifact of a number of small communities.

Before presenting additional results in favor of the theoretical mechanism, we give a possible explanation for the fairly high capitalization rates for municipal real net funds

and municipal equity. The capitalization rates are between approximately 40 and 75 percent for real net funds and 80 to 100 percent for municipal equity. Full capitalization is usually rejected for real net funds but not for municipal equity. The exact size of the empirical capitalization rates for diverse variables are still open for discussion in the literature which mainly focused on property taxes in United States local jurisdictions. While, for example, Oates (1973), Church (1974) and Reinhard (1981) report full or overcapitalization of property taxes, studies such as Edel and Sclar (1974) or the comprehensive study of Yinger, Bloom, Börsch-Supan, and Ladd (1988) show modest capitalization rates compared to other analyses. Using data on municipal utility districts in the northwest suburbs of Houston (Texas) where public goods provision is almost identical for each district but tax rates largely differ, Palmon and Smith (1998) show that capitalization rates for taxes are clearly above 60 percent and full capitalization cannot be rejected.

Still, the capitalization rates for real net funds and equity presented in this paper may be biased upwards. Although minimum standards for a number of local public goods are set by the cantonal or federal governments, municipalities differ with respect to provision levels to some extent. Suppose we cannot control perfectly for public services. True public services g_{true} are measured as $g_{measured} = g_{true} + g_{error}$. If higher municipal wealth is used thoughtfully and is not simple wasted, g_{true} and municipal wealth will be positively correlated. The same holds for g_{error} and a community's asset and debt situation. As we only control for public services with $g_{measured}$ the coefficient for our measures is likely to be higher than its true value. Still, the main intention of this paper is to show the existence of the capitalization channel. The exact size of the capitalization rate is secondary.

We provide additional evidence for debt capitalization using different measures of municipal wealth, and we perform a number of robustness tests which are presented in Table 4.[24]

[24] We decided to analyze in robustness tests the specification which uses the largest number of control variables for public goods and demographics in order to estimate the most stringent and conservative specification. Decreasing the number of control variables leads to stronger results for the respective measures.

< Table 4 here >

For specification (1) and (2) we consider a new measure of municipal assets and debts. The Statistical Office of the Canton of Zurich reports a net funds measure which includes accruals, deferrals and provisions. This measure is widely used inside the office itself and also for its reports on communal finances. It is a rather volatile measure with a high standard deviation as especially accruals and deferrals tend to change from December 31 to January 1, depending on bookkeeping practices. Therefore, net funds reported by the Statistical Office do not necessarily represent the assets a community really has and the actual obligations it faces in the future. As it is a widely applied and recognized indicator in the Canton of Zurich, we use it for robustness tests. Net funds still capitalize positively and at the 1-%-level. When estimating a semi-logarithmic form the positive and significant effect remains as shown in specification (2) .

Municipal self-financing capacity is a hotly discussed topic in Switzerland. The Statistical Office reports a self-financing measure which is constructed using a number of different accounts linked to amortization, expenditures and revenues. The indicator represents approximately a managerial Cash Flow measure. Concerning the quality of the self-financing measure some reservations apply. In contrast to net funds and municipal equity, it strongly depends on the current tax multiplier. Moreover, as financial transfers depend on the self-financing capacity this measure is likely to be biased downward. Still the downward bias is systematic for all communities and should therefore be captured by the error term. Specification (3) presents results of the simple amenity model and in specification (4) we estimate a semi-logarithmic form. In both cases the self-financing capacity capitalizes positively and statistically significant at the 1-%-level.

Moreover, we use a hypothetical measure for the theoretical number of years it takes a municipality to fully pay back all its obligations. This measure takes all municipal debts and divides them by the total income tax revenue. The longer it (theoretically) takes a community to settle its obligation the more likely taxes will increase in the future. We would therefore expect a negative sign of this debt repayment indicator.[25] Indeed,

[25]Leeds (1985) uses a similar measure when analyzing underfunding problems of local pensions in the Chicago area.

as specifications (5) and (6) show, its influence is negative and highly significant.

To determine whether the indicators of the communal financial situation have a multidimensional character, we employ principal component analysis. It turns out that the four variables real net funds, net funds, self financing and debt repayment can be represented as a one dimensional construct. The first component explains approximately 60 percent of the total variance and only the self financing measure points to a possible second dimension. This finding show that the various indicators provide similar information on the latent variables concerning the financial situation of a community.[26] Retaining one principal component's coordinates as a measure for municipal funds, specification (7) presents results of the amenity model and specifiaction (8) is the semi-logarithmic form. In both cases the fund component has a positive influence on house prices and is significant at the 1-%-level.

We note that, broadly, all other control variables do not change in their significance level when compared to the baseline results. The explanatory value of all regressions is above 88 percent.[27]

4 Conclusion

Forward-looking individuals understand that a government's borrowing today implies higher taxes in the future. In Barro's (1974) model the current generation's utility function includes the utility of the next generation which includes the utility of the next generation and so forth. Individuals increase their savings as a reaction to higher budget deficits in order to enable the future generation to pay back public debts. The assumptions for this so called Ricardian equivalence to hold are quite demanding. In modern, open economies or for local jurisdictions another mechanism is likely to be more compelling: Debt capitalization in property values.

[26] Figure A1 in the appendix provides results of a Scree Test for the retention of one component and a Factor Map. Table A1 gives results from the Principal Component Analysis.

[27] Table A2 in the appendix reports for bootstrap results for for specifications (1) to (6) of Table 4. We run 999 bootstrap estimations to obtain a clearer and unbiased view of the coefficients. Using the procedure as described by Davison and Hinkley (1997) we derived the empirical bias of the OLS regressions and also calculate the bootstrapped standard deviations. The results are similar to Table 4 and the estimation bias is very small.

We have argued that even non-altruistic individuals are not able to accumulate debts at the expense of future generations. Real estate persist over time. The value of property depends on current and future taxes and public services as well as on a number of location specific amenities. Individuals bid high prices for real estate in communities with persistently low taxes and high quality public goods. They know that low municipal net funds and low equity lead to higher taxes in the future as debts have to be repaid and reserves have to be replenished. If a generation had the idea to (non-altruistically) accumulate debts in order to put a burden on the future generation, their brainchild backfires. The value of the debt issuing generation's houses decrease to the same extent as the discounted value of taxes to future generations increases. The buying generation simply decreases its bids for properties in indebted communities.

Using a panel dataset for municipalities in the Swiss metropolitan of Zurich, we test our theoretical predictions. Switzerland is an ideal laboratory for this test. The Swiss federal court has ruled out the possibility of a municipal bail out by higher government levels in the well publicized case of the community of Leukerbad. Moreover, Swiss municipalities have the possibility to levy income taxes via a municipal tax multiplier on the cantonal income tax, and they have free access to capital markets. Communal property management is a sacred issue as communities link it with sovereignty. Finally, all municipalities in the Canton of Zurich use a modern and comparable, harmonized accounting system which provides several measures for municipal debts, assets and equity.

Our empirical results confirm the theoretical predictions. Municipalities with high debts have also lower property prices. The effect is stable even when considering a large array of independent controls. In robustness tests we show that a number of different measures for a communities debt and assets capitalize positively as well, making a strong argument for the equivalence of taxes and debts at the local level.

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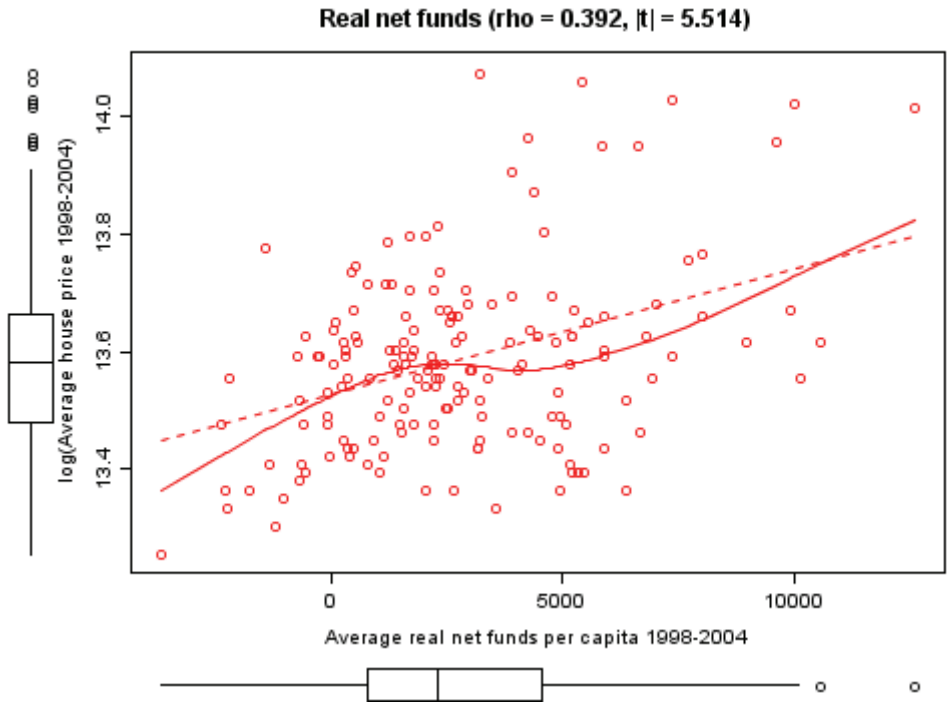
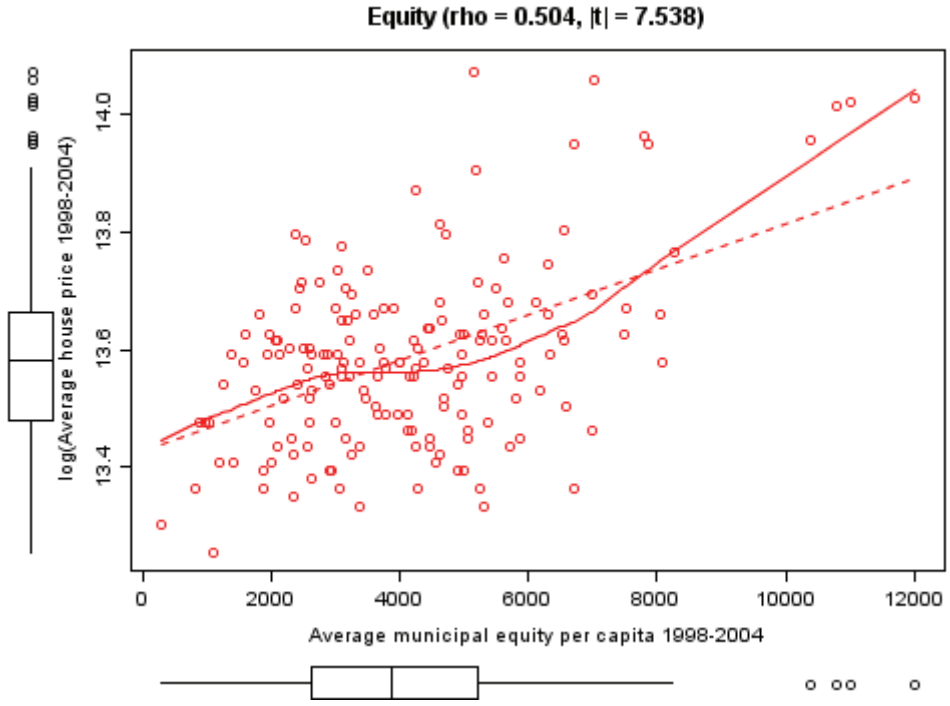
Figure 1
Real Net Funds, Equity, Tax Multipliers and Property Values





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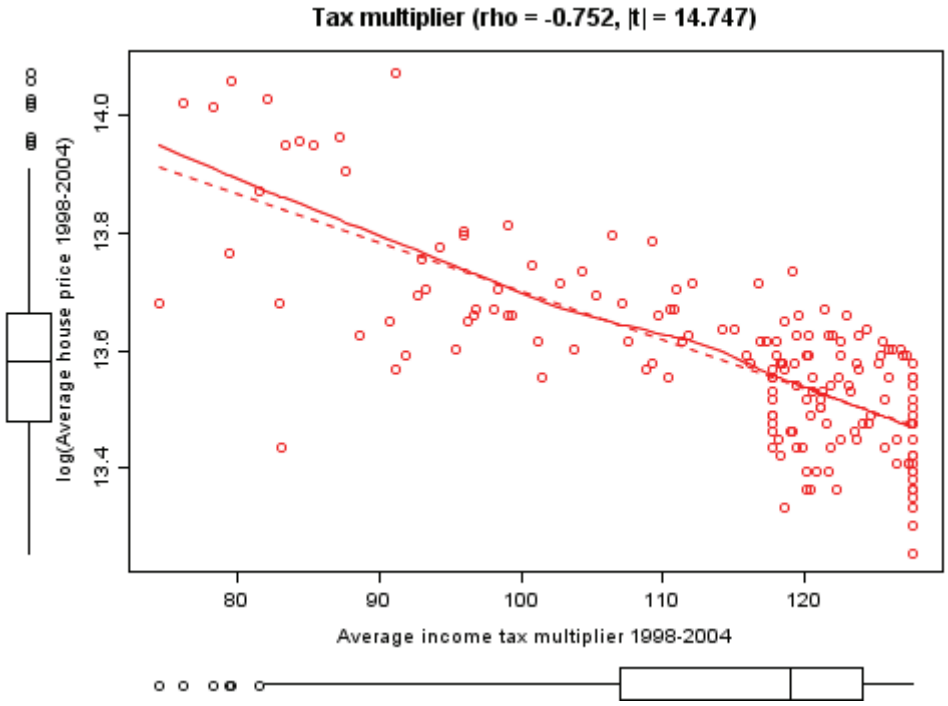


Source: own representation.
The first figure shows the correlation between average real net funds per capita from 1998 to 2004 and log(Average house price from 1998 to 2004). The second figure shows the correlation between average municipal equity per capita from 1998 to 2004 and log(Average house price from 1998 to 2004). The third figure shows the correlation between the average income tax multiplier from 1998 to 2004 and log(Average house price from 1998 to 2004). rho represents the Spearman correlation coefficient. The Box-Whisker-Plots on the x and y axis represent the distribution of the respective variables. The whiskers extend to the most extreme data point which is no more than 1.5 times the interquartile range from the box. The dashed line represents the linear relationship between the two variables. For the solid line a LOESS smoother which uses locally polynomial regressions with smoother span 0.75 was applied.

Table 1
Data Description and Sources

Variable	*Description and source*	*Median*	*Mean*	*S.d.*
HousePrice	Price in Swiss Francs of standardized and comparable single family house. Cantonal Bank of Zurich.	787600	804500	134628
RealNetFunds	Value of liquidities, assets and equipment minus regular obligations, short-term debts and long-term debts per capita. GEFIS Financial Statistics	2369.00	2767.00	2938.14
Equity	Equity per capita from municipal balance sheets. GEFIS Financial Statistics and Statistical Office of the Canton of Zurich.	3632.00	4118.00	2484.27
NetFunds	As RealNetFunds but including accruals, deferrals and provisions. GEFIS Financial Statistics and Statistical Office of the Canton of Zurich.	1883.00	2107.00	3113.10
SelfFinancing	Official indicator for municipal self-financing capacity per capita. GEFIS Financial Statistics and Statistical Office of the Canton of Zurich.	582.000	672.400	526.171
DebtRepay	Number of (theoretical) years for full debt repayment using tax revenues only (total debts divided by total tax revenues). GEFIS Financial Statistics and Statistical Office of the Canton of Zurich.	1.370	1.724	1.278
TaxMultiplier	Mean income tax multiplier (without churches). Statistical Office of the Canton of Zurich.	119.000	113.900	14.880
ExpAgg	Aggregated expenditures for culture, health, administration and social well-being per capita. GEFIS Financial Statistics and Statistical Office of the Canton of Zurich.	484.000	541.200	242.302
MedianIncome	Median income to tax of natural persons. Statistical Office of the Canton of Zurich.	46550	47280	5761.90
ClassSize	Average class size in primary school. Secretary for Education of the Canton of Zurich.	20.300	19.900	1.831
DistSchool	Average distance to schools in meter. Cantonal Bank of Zurich and Statistical Office of the Canton of Zurich (GIS system).	852.500	864.700	226.489
NoSchoolComm	Identificator whether the school is managed by the community itself or a separate school community. Secretary for Education of the Canton of Zurich.	0.000	0.197	0.398
Lakeview	View on lake in number of hectare. Cantonal Bank of Zurich and Statistical Office of the Canton of Zurich (GIS system).	11.850	362.100	869.598
DistCenter	Average time in minutes to Zurich main station. Cantonal Bank of Zurich and Statistical Office of the Canton of Zurich (GIS system).	26.730	26.810	8.569
NO2Pollution	Environmental damage as NO2 in microgram per cubic meter. Cantonal Bank of Zurich and Statistical Office of the Canton of Zurich (GIS system).	17.000	17.770	4.171
SWExposition	Percentage of hectare with south and west exposition. Cantonal Bank of Zurich and Statistical Office of the Canton of Zurich (GIS system).	0.400	0.428	0.275
Density	Population per square kilometer. Statistical Office of the Canton of Zurich.	400.800	597.700	598.265
Commuters	Fraction of commuters outgoing over labor force in community. Statistical Office of the Canton of Zurich.	0.698	0.689	0.069

Elderly	Fraction of population over 65 years. Statistical Office of the Canton of Zurich.	12.300	12.580	2.988
Unemployment	Unemployment rate. Statistical Office of the Canton of Zurich.	2.000	2.231	1.238
Foreigners	Fraction of foreigners. Statistical Office of the Canton of Zurich.	12.000	13.240	7.589

Source: as mentioned in table
The median, mean and standard deviations are based on 1183 observations which are 169 municipalities from 1998 to 2004.

Table 2

Capitalization of Municipal Real Net Funds and Equity

	(1 – Pooling) *RealNetFunds*		*(2 – Pooling)* *Equity*		*(3 – Within)* *RealNetFunds*		*(4 – Within)* *Equity*		*(5 – Within)* *RealNetFunds*		*(6 – Within)* *Equity*	
Variable	*Coefficient*	*Impact* in CHF*	*Coefficient*	*Impact* in CHF*	*Coefficient*	*Impact* in CHF*	*Coefficient*	*Impact* in CHF*	*Coefficient*	*Impact* in CHF*	*Coefficient*	*Impact* in CHF*
RealNetFunds	**1.165[c]**	**32.22**			**1.059[c]**	**29.31**			**1.736[a]**	**48.02**		
	(0.670)				**(0.636)**				**(0.625)**			
Equity			**2.427[a]**	**99.93**			**2.106[a]**	**86.74**			**2.185[a]**	**89.97**
			(0.720)				**(0.692)**				**(0.662)**	
TaxMultiplier	-943.077[a]	-1073.84	-944.960[a]	-1075.98	-908.407[a]	-1034.36	-908.673[a]	-1034.67	-644.111[a]	-733.42	-721.719[a]	-821.79
	(202.453)		(193.469)		(195.883)		(188.335)		(199.937)		(190.106)	
ExpAgg	128.288[a]	694.25	125.600[a]	679.70	156.935[a]	849.28	153.334[a]	829.79	123.953[a]	670.79	121.221[a]	656.01
	(11.348)		(11.147)		(12.646)		(12.522)		(12.955)		(12.918)	
MedianIncome	6.698[a]	3166.38	6.482[a]	3064.45	7.752[a]	3664.62	7.550[a]	3569.24	7.394[a]	3495.58	7.206[a]	3406.51
	(0.534)		(0.540)		(0.540)		(0.547)		(0.541)		(0.551)	
ClassSize	-399.201		-302.515		-84.611		-6.665		909.177		908.634	
	(933.100)		(920.568)		(883.991)		(873.882)		(895.291)		(890.923)	
DistSchool	-38.861[a]	-336.04	-38.418[a]	-332.21	-33.850[a]	-292.71	-33.660[a]	-291.07	-30.094[a]	-260.24	-30.781[a]	-266.17
	(6.606)		(6.601)		(6.531)		(6.539)		(6.487)		(6.575)	
NoSchoolComm	4162.595		4721.044		5026.555		5462.866		2175.826		2712.633	
	(4359.712)		(4323.591)		(4153.344)		(4123.090)		(4081.998)		(4065.800)	
Lakeview	38.510[a]	139.43	38.010[a]	137.62	37.036[a]	134.10	36.648[a]	132.69	36.261[a]	131.29	35.636[a]	129.03
	(2.137)		(2.105)		(1.999)		(1.969)		(1.915)		(1.887)	
DistCenter	-6379.156[a]	-1709.98	-6377.065[a]	-1709.42	-5750.671[a]	-1541.51	-5775.162[a]	-1548.08	-6065.151[a]	-1625.81	-6127.633[a]	-1642.56
	(298.074)		(297.741)		(307.847)		(309.674)		(327.215)		(330.727)	
NO2Pollution	-6507.663[a]	-1156.18	-6527.728[a]	-1159.75	-6423.669[a]	-1141.26	-6446.054[a]	-1145.24	-6482.180[a]	-1151.66	-6560.768[a]	-1165.62
	(649.393)		(653.686)		(618.665)		(623.259)		(569.532)		(575.499)	
SWExposition	80860.153[a]	346.32	79580.825[a]	340.84	73285.469[a]	313.88	72445.452[a]	310.28	69873.021[a]	299.27	68978.805[a]	295.44
	(5943.296)		(5852.173)		(5606.298)		(5545.018)		(5586.747)		(5526.502)	
Density	20.782[a]	124.20	21.937[a]	131.11	15.573[a]	93.08	16.791[a]	100.36	10.558[b]	63.10	11.804[b]	70.55
	(5.329)		(5.331)		(5.100)		(5.124)		(4.872)		(4.899)	
Commuters	-144927.724[a]	-998.60	-142385.854[a]	-981.09	-127272.841[a]	-876.95	-126040.198[a]	-868.46	-52733.145[c]	-363.35	-53201.805[c]	-366.58
	(29068.788)		(29088.338)		(28855.355)		(29072.169)		(28223.293)		(28411.241)	
Elderly									5131.068[a]	645.40	4924.246[a]	619.39
									(709.594)		(696.571)	

Continued on next page.

Unemployment					-7418.031[a] (2171.435)	-165.52
Foreigners					1434.634[a] (363.351)	189.90
(Incercept)	888856.595[a] (56235.339)	890118.438[a] (55283.031)				
Year fixed effects	NO	NO	YES	YES	YES	YES
Adj. R2	0.873	0.874	0.883	0.883	0.890	0.890
N	1183 (169)	1183 (169)	1183 (169)	1183 (169)	1183 (169)	1183 (169)
Capitalization rate of financial measure in %	48.5	101.1	44.1	87.7	72.3	91.0
Full capitalization test; Chi-value (p-value)	4.125 (0.042)	0.002 (0.968)	5.215 (0.022)	0.203 (0.653)	1.336 (0.248)	0.115 (0.734)

Source: own calculations

* The impact of a one percent increase of the mean of the respective independent variable on property prices.

Robust standard errors using a White heteroskedasticity adjusted sandwich estimator for panel data are given in parenthesis. The capitalization rate of the financial measure indicates the capitalization rate of real net funds and municipal equity respectively supposing that a singly family house is inhabited by three persons on average and 80 % of tax revenue stems from natural persons. The full capitalization test indicates whether the coefficient for the variable RealNetFunds or Equity is significantly different from the value that theoretically indicates full capitalization.

[a] indicates a significance level of below 1 %; [b] indicates a significance level between 1 and 5 %; [c] indicates significance level between 5 and 10 %.

Table 3

Robustness Tests for the Capitalization Thesis

	semi-logarithmic		*logarithmic*		*WLS – log(Pop)*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Variable	*RealNetFunds*	*Equity*	*RealNetFunds*	*Equity*	*RealNetFunds*	*Equity*
RealNetFunds	**1.21E-06[c]**		**2.33E-02[c]**		**1.830[a]**	
	(7.32E-07)		**(1.38E-02)**		**(0.624)**	
Equity		**1.36E-06[c]**		**4.11E-03[b]**		**2.415[a]**
		(7.71E-07)		**(2.01E-03)**		**(0.662)**
TaxMultiplier	-6.95E-04[a]	-7.58E-04[a]	-9.51E-02[a]	-1.05E-01_a	-568.271[a]	-641.191[a]
	(2.32E-04)	(2.20E-04)	(2.39E-02)	(2.26E-02)	(197.963)	(187.979)
ExpAgg	1.25E-04[a]	1.24E-04[a]	5.50E-02[a]	5.44E-02_a	122.567[a]	119.692[a]
	(1.43E-05)	(1.43E-05)	(6.63E-03)	(6.56E-03)	(12.833)	(12.808)
MedianIncome	7.81E-06[a]	7.70E-06[a]	3.68E-01[a]	3.63E-01_a	7.756[a]	7.551[a]
	(6.19E-07)	(6.28E-07)	(3.07E-02)	(3.13E-02)	(0.557)	(0.565)
ClassSize	-3.14E-03[a]	-3.13E-03[a]	-2.60E-03[b]	-2.54E-03_b	-876.075	-894.253
	(1.02E-03)	(1.02E-03)	(1.02E-03)	(1.02E-03)	(914.554)	(907.764)
DistSchool	-4.59E-05[a]	-4.65E-05[a]	-4.55E-05[a]	-4.66E-05_a	-27.894[a]	-28.427[a]
	(7.97E-06)	(8.09E-06)	(8.07E-06)	(8.32E-06)	(6.665)	(6.732)
NoSchoolComm	-2.33E-03	-2.00E-03	-1.19E-03	-9.65E-04_	1778.447	2486.101
	(4.50E-03)	(4.50E-03)	(4.53E-03)	(4.54E-03)	(3987.475)	(3966.929)
Lakeview	4.38E-05[a]	4.33E-05[a]	4.21E-05[a]	4.16E-05_a	35.619[a]	34.937[a]
	(2.13E-06)	(2.10E-06)	(2.05E-06)	(2.02E-06)	(1.874)	(1.839)
DistCenter	-8.15E-03[a]	-8.20E-03[a]	-8.39E-03[a]	-8.47E-03_a	-5959.537[a]	-6018.155[a]
	(3.67E-04)	(3.71E-04)	(3.64E-04)	(3.67E-04)	(337.838)	(340.933)
NO2Pollution	-7.46E-03[a]	-7.52E-03[a]	-7.65E-03[a]	-7.80E-03_a	-6698.123[a]	-6771.902[a]
	(6.38E-04)	(6.38E-04)	(6.45E-04)	(6.47E-04)	(563.773)	(568.715)
SWExposition	9.00E-02[a]	8.94E-02[a]	8.99E-02[a]	9.02E-02_a	71728.742[a]	70697.913[a]
	(6.41E-03)	(6.35E-03)	(6.38E-03)	(6.36E-03)	(5649.217)	(5589.117)
Density	1.24E-05[b]	1.32E-05[b]	1.80E-05[a]	1.81E-05_a	10.250[b]	11.679[b]
	(5.31E-06)	(5.35E-06)	(5.49E-06)	(5.49E-06)	(4.716)	(4.747)
Commuters	-4.83E-02	-4.84E-02	-7.84E-02[b]	-7.75E-02_b	-54811.834[b]	-56169.734[b]
	(3.40E-02)	(3.43E-02)	(3.41E-02)	(3.45E-02)	(27695.519)	(27770.540)
Elderly	3.43E-03[a]	3.28E-03[a]	4.68E-03[a]	4.55E-03_a	5739.167[a]	5523.242[a]
	(7.88E-04)	(7.76E-04)	(7.22E-04)	(7.15E-04)	(718.387)	(704.490)
Unemployment	-7.92E-03[a]	-7.68E-03[a]	-6.72E-03[b]	-6.52E-03_b	-7740.159[a]	-7344.409[a]
	(2.59E-03)	(2.59E-03)	(2.65E-03)	(2.66E-03)	(2104.539)	(2116.004)
Foreigners	1.91E-03[a]	1.85E-03[a]	1.79E-03[a]	1.75E-03_a	1526.611[a]	1417.575[a]
	(4.28E-04)	(4.28E-04)	(4.39E-04)	(4.40E-04)	(355.167)	(354.035)
Year fixed effects	YES	YES	YES	YES	YES	YES
Adj. R2	0.887	0.887	0.885	0.885	0.896	0.895
N	1183	1183	1183	1183	1183	1183
	(169)	(169)	(169)	(169)	(169)	(169)

Source: own calculations

In specifications (1) and (2) the dependant variable is expressed in logs. In specifications (3) and (4) all monetary variables are expressed in logs. Specifications (5) and (6) are weighted least square estimates where the respective municipal log(population) is used a weight.

[a] indicates a significance level of below 1 %; [b] indicates a significance level between 1 and 5 %; [c] indicates significance level between 5 and 10 %.

Table 4

Robustness Tests for Capitalization Thesis with other Measures for Municipal Financial Situation

	Different Measures and Specifications							
Variable	*(1) NetFunds*	*(2 semi-log) NetFunds*	*(3) SelfFin.*	*(4 semi-log) SelfFin.*	*(5) DebtRepay*	*(6 semi-log) DebtRepay*	*(7) Fund Component*	*(8 semi-log) Fund Component*
Municipal asset and debt measure	**2.02E+0[a] (6.05E-1)**	**1.95E-6[a] (7.14E-7)**	**1.50E+1[a] (3.70E+0)**	**1.63E-5[a] (3.79E-6)**	**-5.27E+3[a] (1.42E+3)**	**-8.75E-3[a] (1.75E-3)**	**5.34E+3[a] (1.21E+3)**	**5.36E-3[a] (1.43E-3)**
TaxMultiplier	-5.55E+2[a]	-5.56E-4[b]	-9.03E+2[a]	-8.98E-4[a]	-7.37E+2[a]	-6.56E-4[a]	-5.16E+2[a]	-5.05E-4[b]
	(2.02E+2)	(2.33E-4)	(1.83E+2)	(2.10E-4)	(1.87E+2)	(2.15E-4)	(1.97E+2)	(2.29E-4)
ExpAgg	1.25E+2[a]	1.26E-4[a]	1.32E+2[a]	1.34E-4[a]	1.26E+2[a]	1.29E-4[a]	1.25E+2[a]	1.26E-4[a]
	(1.29E+1)	(1.42E-5)	(1.35E+1)	(1.50E-5)	(1.29E+1)	(1.40E-5)	(1.29E+1)	(1.42E-5)
MedianIncome	7.46E+0[a]	7.86E-6[a]	7.01E+0[a]	7.36E-6[a]	7.36E+0[a]	7.68E-6[a]	7.21E+0[a]	7.61E-6[a]
	(5.37E-1)	(6.09E-7)	(5.70E-1)	(6.34E-7)	(5.48E-1)	(6.16E-7)	(5.44E-1)	(6.19E-7)
ClassSize	-7.60E+2	-3.05E-3[a]	-8.87E+2	-3.20E-3[a]	-1.04E+2	-2.00E-3[b]	-7.65E+2	-3.06E-3[a]
	(8.92E+2)	(1.01E-3)	(8.84E+2)	(9.99E-4)	(9.09E+2)	(1.01E-3)	(8.82E+2)	(1.00E-3)
DistSchool	-2.95E+1[a]	-4.48E-5[a]	-3.26E+1[a]	-4.78E-5[a]	-3.12E+1[a]	-4.57E-5[a]	-2.88E+1[a]	-4.40E-5[a]
	(6.42E+0)	(7.86E-6)	(6.50E+0)	(8.00E-6)	(6.25E+0)	(7.48E-6)	(6.25E+0)	(7.67E-6)
NoSchoolComm	2.64E+3	-1.86E-3	1.44E+3	-3.10E-3	2.14E+3	-2.32E-3	2.58E+3	-1.90E-3
	(4.07E+3)	(4.48E-3)	(4.03E+3)	(4.42E-3)	(4.11E+3)	(4.48E-3)	(4.04E+3)	(4.45E-3)
Lakeview	3.62E+1[a]	4.38E-5[a]	3.55E+1[a]	4.32E-5[a]	3.55E+1[a]	4.30E-5[a]	3.61E+1[a]	4.38E-5[a]
	(1.92E+0)	(2.12E-6)	(1.86E+0)	(2.04E-6)	(1.91E+0)	(2.09E-6)	(1.88E+0)	(2.08E-6)
DistCenter	-6.03E+3[a]	-8.10E-3[a]	-6.06E+3[a]	-8.11E-3[a]	-6.00E+3[a]	-7.96E-3[a]	-5.98E+3[a]	-8.04E-3[a]
	(3.28E+2)	(3.67E-4)	(3.32E+2)	(3.73E-4)	(3.40E+2)	(3.82E-4)	(3.30E+2)	(3.68E-4)
NO2Pollution	-6.42E+3[a]	-7.35E-3[a]	-6.86E+3[a]	-7.80E-3[a]	-6.62E+3[a]	-7.51E-3[a]	-6.41E+3[a]	-7.33E-3[a]
	(5.76E+2)	(6.45E-4)	(5.80E+2)	(6.46E-4)	(5.72E+2)	(6.38E-4)	(5.77E+2)	(6.46E-4)
SWExposition	6.86E+4[a]	8.88E-2[a]	6.95E+4[a]	8.96E-2[a]	6.72E+4[a]	8.57E-2[a]	6.81E+4[a]	8.82E-2[a]
	(5.51E+3)	(6.32E-3)	(5.42E+3)	(6.23E-3)	(5.48E+3)	(6.23E-3)	(5.50E+3)	(6.32E-3)
Density	1.10E+1[b]	1.31E-5[b]	8.70E+0[c]	1.07E-5[b]	9.63E+0[b]	1.17E-5[b]	1.15E+1[b]	1.36E-5[a]
	(4.86E+0)	(5.29E-6)	(4.81E+0)	(5.27E-6)	(4.79E+0)	(5.14E-6)	(4.83E+0)	(5.26E-6)
Commuters	-5.46E+4[c]	-5.07E-2	-3.22E+4	-2.69E-2	-6.87E+4[b]	-7.70E-2[b]	-5.82E+4[b]	-5.45E-2
	(2.81E+4)	(3.38E-2)	(2.86E+4)	(3.45E-2)	(2.73E+4)	(3.22E-2)	(2.77E+4)	(3.33E-2)
Elderly	5.18E+3[a]	3.54E-3[a]	4.21E+3[a]	2.52E-3[a]	5.08E+3[a]	3.58E-3[a]	5.14E+3[a]	3.52E-3[a]
	(7.06E+2)	(7.81E-4)	(6.89E+2)	(7.80E-4)	(6.97E+2)	(7.61E-4)	(6.93E+2)	(7.66E-4)
Unemployment	-7.63E+3[a]	-8.21E-3[a]	-6.78E+3[a]	-7.34E-3[a]	-6.80E+3[a]	-7.19E-3[a]	-7.36E+3[a]	-7.95E-3[a]
	(2.16E+3)	(2.57E-3)	(2.18E+3)	(2.57E-3)	(2.13E+3)	(2.48E-3)	(2.13E+3)	(2.53E-3)
Foreigners	1.41E+3[a]	1.90E-3[a]	1.36E+3[a]	1.84E-3[a]	1.26E+3[a]	1.66E-3[a]	1.35E+3[a]	1.84E-3[a]
	(3.60E+2)	(4.23E-4)	(3.62E+2)	(4.25E-4)	(3.57E+2)	(4.12E-4)	(3.56E+2)	(4.18E-4)
Year fixed effects	YES		YES	YES	YES	YES	YES	YES
Adj. R2	0.890	0.888	0.891	0.890	0.891	0.890	0.892	0.888
N	1183	1183	1183	1183	1183	1183	1183	1183
	(169)	(169)	(169)	(169)	(169)	(169)	(169)	(169)

Source: own calculations

Different measures for real net funds are used in the specifications tested.

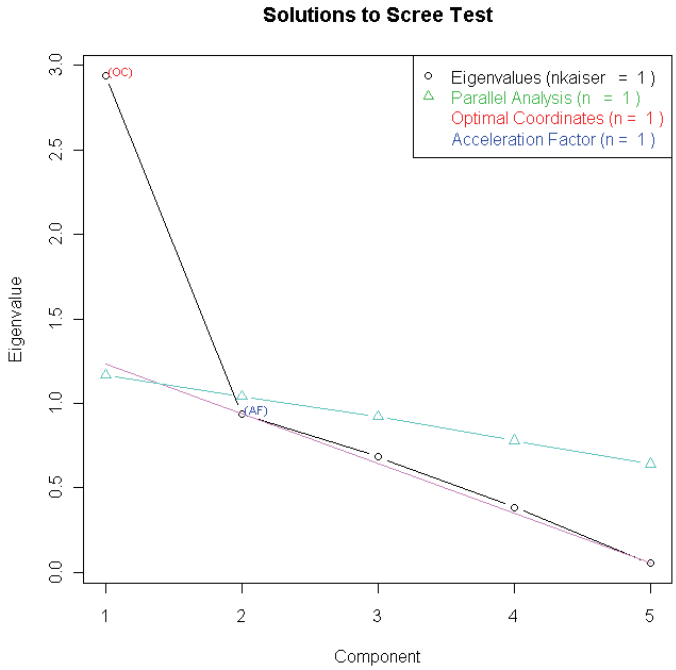
[a] indicates a significance level of below 1 %; [b] indicates a significance level between 1 and 5 %; [c] indicates significance level between 5 and 10 %.

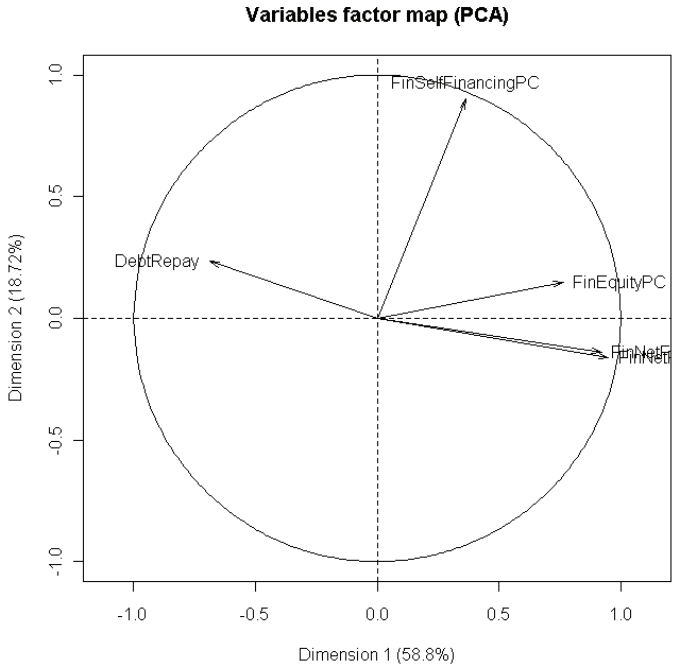
Supplementary Material

(not intended for publication)

Figure A1

Principal Component Analysis – Scree Test and Factor Map





Source: own representation.

The first figure shows the solutions to a Scree test. The eigenvalue criteria suggests to retain one component (second eigenvalue smaller than unity). Results from parallel analysis suggest one component as do results from optimal coordinates and the acceleration factor. The second figure picture a factor map from the principal component analysis. One dimensions explains 58.8 % of total variance.

Table A1

Results from Principal Component Analysis

	Eigenvalues	% of Variance	Cumulative Variance	Pred. EV (optimal coordinates)	Acceleration Factor
Component 1	2.940154	0.588031	0.588031	1.230044	
Component 2	0.936241	0.187248	0.775279	0.997525	1.750967
Component 3	0.683295	0.136659	0.911938	0.716116	-0.04487
Component 4	0.385475	0.077095	0.989033		-0.03282
Component 5	0.054834	0.010967	1		

Source: own calculations

Four variables are employed in the Principal Component Analysis: RealNetFunds, Equity, NetFunds, SelfFinancing, DebtRepay. Predicted eigenvalues result from fitting by each optimal coordinate by a regression line.

Table A2

Bootstrap with Different Measures for Municipal Financial Situation

	Bootstrap					
Variable	*(1) NetFunds*	*(2 semi-log) NetFunds*	*(3) SelfFinancing*	*(4 semi-log) SelfFinancing*	*(5) DebtRepay*	*(6 semi-log) DebtRepay*
Municipal asset and debt measure	**2.024[a]** **(0.561)**	**1.41E-07[a]** **(1.36E-09)**	**14.969[a]** **(2.776)**	**1.19E-06[a]** **(2.45E-07)**	**-5270.724[a]** **(1256.127)**	**-6.57E-04[a]** **(1.09E-04)**
Absolute and relative bias of measure	*0.020* *0.989%*	*1.36E-09* *0.960%*	*0.074* *0.497%*	*-1.37E-08* *-1.151%*	*0.771* *-0.015%*	*1.08E-07* *-0.016%*
TaxMultiplier	-554.985[a] (176.939)	-4.00E-05[a] (1.16E-07)	-902.758[a] (162.271)	-6.49E-05[a] (1.41E-05)	-736.755[a] (167.676)	-4.68E-05[a] (1.42E-05)
ExpAgg	124.540[a] (10.404)	9.13E-06[a] (2.71E-08)	131.799[a] (11.067)	9.71E-06[a] (9.32E-07)	126.483[a] (11.277)	9.40E-06[a] (8.86E-07)
MedianIncome	7.463[a] (0.441)	5.72E-07[a] (2.25E-09)	7.006[a] (0.430)	5.35E-07[a] (3.81E-08)	7.357[a] (0.441)	5.58E-07[a] (3.66E-08)
ClassSize	-760.361 (779.702)	-2.35E-04 (-6.13E-06)	- 886.899 (754.997)	-2.46E-04[a] (6.56E-05)	-103.909 (787.854)	-1.56E-04[b] (6.61E-05)
DistSchool	-29.537[a] (6.428)	-3.34E-06[a] (3.18E-08)	-32.613[a] (6.581)	-3.56E-06[a] (5.58E-07)	-31.240[a] (6.584)	-3.40E-06[a] (5.50E-07)
NoSchoolComm	2642.885 (3816.199)	-1.61E-04 (1.16E-05)	1440.693 (3546.132)	-2.51E-04 (3.07E-04)	2142.613 (3745.738)	-1.93E-04 (3.11E-04)
Lakeview	36.192[a] (1.911)	3.22E-06[a] (-6.98E-09)	35.508[a] (1.821)	3.17E-06[a] (1.56E-07)	35.513[a] (1.951)	3.16E-06[a] (1.58E-07)
DistCenter	-6034.426[a] (294.523)	-5.99E-04[a] (1.84E-06)	-6058.890[a] (278.511)	-6.00E-04[a] (2.45E-05)	-5996.564[a] (308.830)	-5.88E-04[a] (2.46E-05)
NO2Pollution	-6419.095[a] (490.984)	-5.38E-04[a] (-1.01E-06)	-6858.995[a] (504.971)	-5.71E-04[a] (4.33E-05)	-6621.444[a] (504.172)	-5.50E-04[a] (4.11E-05)
SWExposition	68627.335[a] (5504.916)	6.55E-03[a] (2.29E-05)	69459.045[a] (5009.360)	6.61E-03[a] (4.25E-04)	67228.837[a] (5214.712)	6.32E-03[a] (4.25E-04)
Density	11.023[b] (4.327)	9.59E-07[b] (-5.39E-09)	8.703[c] (4.271)	7.87E-07[b] (3.73E-07)	9.630[b] (4.433)	8.54E-07[b] (3.60E-07)
Commuters	-54589.406[c] (26999.130)	-3.63E-03[c] (-1.60E-04)	-32234.092 (26467.340)	-1.89E-03 (2.33E-03)	-68663.132[b] (27544.000)	-5.61E-03[b] (2.30E-03)
Elderly	5183.588[a] (689.959)	2.47E-04[a] (4.43E-06)	4212.306[a] (720.690)	1.73E-04[a] (5.89E-05)	5079.994[a] (714.001)	2.50E-04[a] (5.63E-05)
Unemployment	-7632.640[a] (2251.260)	-5.99E-04[a] (-4.42E-06)	-6779.255[a] (2233.545)	-5.37E-04[a] (1.89E-04)	-6801.338[a] (2026.295)	-5.24E-04[a] (1.82E-04)
Foreigners	1413.350[a] (368.108)	1.41E-04[a] (1.82E-06)	1355.431[a] (361.665)	1.37E-04[a] (3.08E-05)	1258.875[a] (359.664)	1.23E-04[a] (3.08E-05)
Year fixed effects	YES	YES	YES	YES	YES	YES
Adj. R2	0.890	0.888	0.892	0.890	0.891	0.891
N	1183 (169)	1183 (169)	1183 (169)	1183 (169)	1183 (169)	1183 (169)

Source: own calculations

Different measures for real net funds are used in the specifications tested. Bootstrapping estimates represent 999 bootstrapped OLS estimates and bootstrapped standard errors.

[a] indicates a significance level of below 1 %; [b] indicates a significance level between 1 and 5 %; [c] indicates significance level between 5 and 10 %.