**Choice and Efficiency in Education: New Perspective on the Tiebout Model**

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Abstract The aspiration to achieve universal access to quality education for all is often accompanied by the challenge of efficiency. Commonly, public good provision (e.g., education) is perceived as less efficient than private markets (Samuelson, 1954).

The literature on the relationship between locational choice and efficiency reveals a positive relationship, using the ratio of achievement and per student public expenditures as indicators of educational efficiency (e.g., Hoxby, 2000; Muralidharan & Sundararaman, 2015). Not looking at household expenditure on private tutoring from an efficiency measurement might lead to biased results and a misleading understanding on the relationship between choice and efficiency.

This work examines the relationships between the degree of location-based choice and the efficiency of education markets (Hoxby, 1996; Rothstein, 2007; Tiebout, 1956). Furthermore, this work develops an innovative indicator for measuring efficiency, using the ratio between achievement and the overall educational expenditures (i.e., household and public expenditure on education).

Data sets from the Israeli longitudinal nation-wide survey are analyzed. Using Generalized Method of Moments (GMM) regression models (Chen, Hong, & Tarozzi, 2008; Hansen, 1982) and the Simpson’s bio-diversity index as an instrumental variable (IV) (Simpson, 1949; White, 1986), the impact of choice on efficiency is analyzed. Using a new indicator for efficiency, the findings reveal a lower impact of choice on efficiency (compared with traditional efficiency indicators). Our findings might assist policy-makers in other countries who aspire to increase educational efficiency, and understand why choice might not be the way to do so.

**Keywords** School finance, Public goods, State and local government, Government expenditures, Education

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13.1 Introduction

Economic efficiency, prevalent in free markets, is compromised when public goods (e.g., education) are supplied (Hanushek, 2002; Samuelson, 1954). The decline in efficiency occurs since public goods are financed through government compulsory taxation and moreover, since the quantity and quality of publicly-provided goods is centrally determined and is detached from voluntary decision-making made in free markets (Hillman, 2009).

The behavioral aspects of the failure to reach efficient outcomes in the provision of public goods are related to the free-rider problem. The free-rider problem arises from the predisposition of self-interested individuals to truthfully reveal their unwillingness to pay for the public goods. This calls for market correction through government intervention. The government is ought to publicly supply public goods by collecting taxes.The free rider problem, may lead to the under provision of the public good.

However, this conjecture is refuted by Tiebout (1956). Arguing that an economy can be viewed as divided into localities where the quality and quantity of the public goods are uniquely determined. Tiebout’s model encompasses efficient provision of public goods. Tiebout’s narrative describes households as seeking a location which corresponds to their level of preferred taxation which, in turn, determines the quality and quantity of public goods supplied in this location. This voluntary decision solves the free-rider problem, hence will be efficient as in private markets.

Tiebout’s model, as every other theoretical model, entails strict assumptions which are rarely met in reality. It predicts that as choice increases, efficiency increases. For instance, the more school districts there are, the higher the efficiency of the public education system. This is due to the fact that households can sort themselves into homogeneous communities as well as participate in increased competition between school districts (Borland & Howsen, 1992; Hoxby, 2000).

The tradeoff in the provision of public education is that, on the one hand, we aspire to achieve efficient outcomes and simultaneously on the other hand, we aim for equity which is tremendously important in the provision of public education. Each reform which attempts to increase efficiency comes with a cost of sorted more homogeneous communities and less integrated societies (Abrams, 2016).

**13.1.1 Efficiency and Effectiveness**

There are several ways to determine the performance of education systems. The two main strands in the literature which study the performance of education systems are **Education Effectiveness** and **Education Efficiency.**

Research on education effectiveness studies the ability of school systems to achieve their institutional goals by examining non-monetary input and output indicators (Dobbie & Fryer, 2013; Hollands et al., 2016; Levin & Belfield, 2015). These indicators may be, for instance, the number of graduates in a given year, the level of curriculum goals reached, etc. The research on education efficiency, on the other hand, studies the utilization of monetary inputs with respect to produced outputs. The variables studied may be, for instance, per student expenditure, public spending on education, etc. (Afonso & Aubyn, 2006; Rolle, 2016; Wöbmann, Lüdemann, Schütz, & West, 2007).For a comprehensive review and taxonomy of this broad subject, see Lockheed and Hanushek, (1994), Lockheed (1988) and Cornali (2012).

**13.1.2 Efficiency Measurements**

Efficiency measures generally use a function which maps inputs and/or outputs into an index that rates overall performance, where the inputs are expenditures and the outputs are achievements. This measurement clearly cannot take into account many factors which affect the efficiency of education systems and, therefore, new methods have been developed in an attempt to better evaluate the efficiency of schools.

 One of the important advancements in the measurement of efficiency is the value-added model (BenDavid-Hadar, 2018; Hanushek & Rivkin, 2010). The main purpose of value-added modeling is to separate the effects of non-school-related factors (such as family, peer, and individual influence) from a school’s performance at any point in time so that student performance can be attributed appropriately (Cordero-Ferrera, Pedraja-Chaparro, & Salinas-Jiménez, 2008). A value-added estimate for a school is simply the difference between its actual growth and its expected growth. It is important to note that schools can demonstrate positive achievement growth, but still have a value-added estimate that is negative (i.e., the school demonstrated growth, just not as much as we would have predicted, given the student inputs available to the school).

 Value-added modeling is most common in the U.S. and the United Kingdom, and less common in other parts of the world (Organisation for Economic Co-operation and Development [OECD], 2008). However, using value-added modeling for policy initiative needs to be treated with delicacy. Briggs, Weeks, and Wiley (2008) draw attention to the pitfalls of using value-added modeling for policy initiatives.

 Another example of a refinement to the definition of efficiency is its broadening to include additional information on achievements. Here, instead of looking at just the average grade of students in a series of exams, the whole range of grades and difficulty level of each exam is considered. See, for instance, Dadon-Golan (2016) who combined grades and unit numbers for each student matriculation examination.

**13.1.3 Choice**

The research on school efficiency is growing (e.g., Hanushek & Yilmaz, 2011; Rouse & Barrow, 2009). Some argue that one of the strongest forces which increases educational efficiency is the freedom of choice (Friedman, 1962; Hanushek, 2002). In a seminal paper, Friedman (1955) suggested the use of vouchers in an effort to separate the supply and demand of public education.

Choice can be increased by several means, one of which is increasing parental choice. Increasing parental choice can be achieved by increasing alternatives for school registration within a specific jurisdiction, or within jurisdictions using Charter Schools, Private Schools, or vouchers (Abdulkadiroglu, Angrist, & Pathak, 2014; Belfield & Levin, 2002a, 2002b; Cullen, Jacob, & Levitt, 2006; Dobbie & Fryer, 2011; Howell & Peterson, 2002; Howell, Wolf, Campbell, & Peterson, 2002).

Choice may be further increased indirectly. For instance, changing the share of the school budget allocated by central governing bodies and local municipalities affects the power each of these hierarchies possesses. The higher the share of budget coming from central authorities, the lower the level of choice, since central governments usually have less information on local schools and therefore, allocate the budget more uniformly. Uniform allocation leads to less heterogeneity within areas which decreases choice (Hanushek & Yilmaz, 2011). The effect of the freedom of choice on the efficiency of public education systems is controversial, and the findings are inconclusive (Hanushek, Sarpça, & Yilmaz, 2011; Ladd & Fiske, 2003; Montes & Rubalcaba, 2014; Rouse & Barrow, 2009).

One of the important determinants of choice in markets is locational choice (i.e. the diversity of locations available for a household in each area). In choosing its location of residence in a geographically specific area (e.g., a geographical area which is divided by natural boundaries, such as rivers). The larger the alternatives of each household (in terms of more geographically specific areas), the higher the locational choice (Hanushek et al., 2011; Hanushek & Yilmaz, 2011; Ladd & Fiske, 2003). These geographical subdivisions increase the freedom a household enjoy, and this enables the exercise of a more specific choice of levels of public goods supplied and consequently, their preferred level of taxation (Hillman, 2009).

Locational choice focuses on an amongst-areas mechanism of choice rather than a within- areas mechanism of choice, such as in the case of parental choice. Tiebout’s theoretical model defines this positive relationship between locational choice and efficiency. However, the application of this relationship to empirical data is prone to interpretation (Hoxby, 2007; Rothstein, 2007).

Tiebout’s theoretical hypothesis is that citizens will sort themselves geographically to optimally match their preferable level of expenditures on public goods. This sorting will be done to optimize the realization of their preferences and consequently, the level of taxation they are willing to pay. This sorting is meant to allow for increased efficiency when compared with a homogenous, centrally planned economies.

Some support the increase in choice, while others claim that increasing locational choice can lead to sorting which may weaken spillover from heterogeneous student populations: when sorting takes place, good students are concentrated in good schools, and their positive influence on weaker students is decreased. This effect may indeed lower efficiency (Belfield & Levin, 2002b; Borland & Howsen, 1992; Hanushek et al., 2011; Hanushek & Yilmaz, 2011).

**13.1.4 Contribution**

The theoretical contribution of this work lies in the development of a new equilibrium within the Tiebout model framework which accounts for the distortion in equilibrium when the private expenditure of households is excluded from the model assumptions.

The empirical contribution of this work is twofold. First, it includes a design for a unifying method of defining locations and sub-locations that will later be used to determine the extent of locational choice. Second, this location hierarchy allows for empirical analysis of an entire state and is comprised of an analysis of both urban and rural areas (Hoxby, 2000).

Models like ours usually include explanatory variables which are correlated with independent variables (endogenous variables) (Alesina, Baqir, & Hoxby, 2004). Endogeneity produces biased Ordinary Least Squares (OLS) estimators, and requires the use of (IV) which can isolate the endogenous effect (Cameron & Trivedi, 2009). We use Simpson’s species analysis to create a measure of area ethnic heterogeneity by using his bio-diversity index (Simpson, 1949; White, 1986). This ethnic diversity measure will perform as an instrumental variable in our model.

We begin by presenting the model and the method in Sec. 13.‎2 and ‎13.3, respectively. Section 13.3.2 describes the data, Sec. 13.4‎ discusses these results, and Sec. 13.5 provides a discussion and policy recommendations.

13.2 The Model

Tiebout’s theoretical model includes several simplifying assumptions. In his model, consumers have perfect and free information, there are no costs associated with moving, there are many communities from which to choose, an optimal city size exists and is reachable, there are no costs of commuting, and no spillovers from public goods exist (Barseghyan & Coate, 2016; Buchanan & Goetz, 1972). Given this set of assumptions, the following holds:

|  |  |
| --- | --- |
| $$\frac{∂E\_{i}}{∂C\_{i}}>0$$ | 1.
 |

where $E\_{i}$ and $C\_{i}$ are the levels of efficiency and choice in area $i$ respectively (i.e. that efficiency is positively related to Choice). Previous research show that, after solving the Endogeneity issue, this relationship is empirically confirmed (Hoxby, 2000).

**13.2.1 Efficiency**

The contribution of this work focuses on the development of a new measure for the efficiency of public education. We argue that private expenditure of a household on private tutoring is a proxy for school efficiency. The hypothesis is that the higher the private expenditure of an area (*Ceteris Paribus*), the lower the expected efficiency of its schools.

How do we measure the level of educational efficiency in our work? Our framework deals with the economic efficiency of education systems. Traditional measures use the average achievement of students in a school or an area or alternatively, the ratio between the average achievement and per student public expenditure. We use this ratio as the benchmark measure for efficiency. Denote this ratio as $E\_{i}^{0}$,

|  |  |
| --- | --- |
| $$E\_{i}^{0}=^{A\_{i}}/\_{ln\left(PSE\_{i}\right)}$$ |  |

where $A\_{i}$ is the “achievement” area $i$, and $PSE\_{i}$ is the natural logarithm of the “per student expenditure” in area $i. $We compare this measure with the measure we have developed in this work. Denote $E\_{i}^{1}$ as the measure which includes parental expenditure on private tutoring,

|  |  |
| --- | --- |
| $$E\_{i}^{1}=^{A\_{i}}/\_{\left\{ln\left(PSE\_{i}\right)+ln\left(PT\_{i}\right)\right\}}$$ | 1.
 |

where $PT\_{i}$ is the measure of the average household expenditure on private tutoring in area $i$. We hypothesize that the traditional measure of efficiency $E\_{i}^{0}$ which does not include parental expenditure on private tutoring will underperform in the analysis of the relationship of choice and efficiency.

**13.2.2 Choice**

In the previous subsection, multiple measures of choice were reviewed. This work utilizes the measure of locational choice described by Tiebout’s model, and seeks to unveil the relationship of locational choice and efficiency.

One measure of locational choice could be the Herfindahl index (see for example Garcia-Diaz, del Castillo, & Cabral, 2016; Hoxby, 2000). This measure requires the partitioning of areas into sub-areas, and uses the charecteristics of both to determine the level of choice which exists in an area. The characteristics can be population size, land area size or student enrollment. Since we are interested in the locational choice of households, we shall use population size and student enrollment.

We use the letter $j$ for areas and the letter $i$ for sub-areas. Denote $HR\_{j}$ as the Herfindahl population index value assigned to area $j$

|  |  |
| --- | --- |
| $$HR\_{j}=1-\sum\_{i=1}^{n}POP\_{ij}^{2}$$ |  |

where

|  |  |
| --- | --- |
| $$pop\_{ij}=\frac{population in sub-area i}{population in area j}$$ |  |

This measure of locational choice will perform as the explanatory variable in this work.

**13.2.3 Endogeneity**

One of the major challenges in an empirical analysis of choice and efficiency is the endogeneity issue. Since choice is not exogenous, Ordinary Least Squares estimators are biased; the error terms are related to the regressors (Cameron & Trivedi, 2009), i.e.

|  |  |
| --- | --- |
| $$E\left(u\left|x\right.\right)\ne 0$$ | 1.
 |

Suppose we have the following model:

|  |  |
| --- | --- |
| $$y=βx+u$$ | 1.
 |

$x$ affects $y$ only through a directional effect through $β$:

|  |
| --- |
|  |

**Fig. 13.1** Directional effect of x on y

 Suppose *y* is earnings, *x* is schooling, and *u* is the error term which includes all the other factors which affect earnings other than schooling. Such factors may be ability; however, ability affects schooling, therefore the correct model is as described in Fig. 13.2 below:

|  |
| --- |
|  |

**Fig. 13.2** Indirect effect of *x* on *y*

 Suppose further that we know that on average, a year of schooling is associated with a $1000 increase in earnings, but we are not sure how much of it is due to high school, and how much of it is due to ability. Had we had a variable which measured ability, we would be able to generate consistent OLS estimators (called the “control-function approach”); however, such regressors are not always readily available. The IV approach provides an alternative solution.

We introduce a new variable *z*, such that *z* is related to *x* but not to *y* (directly). We then have:

|  |
| --- |
|  |

**Fig. 13.3** Instrumental-Variable

 For example, $z$ may be the distance from school which affects schooling (attendance) but not earnings. This new variable is called the Instrumental-Variable. This helps in resolving the Endogeneity issue in the following method: we first ran this variable in a first stage OLS regression as an explanatory variable, where the endogenous variable in the original model ($x$) is the dependent variable. The predicted values of $x$ from the first stage regression will perform in the second stage regression as regressors for $y$; however, the variable $x$ will no longer be endogenous since it is composed of the predicted values from the first stage regression which still contain the information of the original variable $x$, but are now not correlated with the error term.

This method is known as Two-Stage Least Squares (2SLS), and is a private case of the more general method Generalized Method of Moments (GMM) which allows for more freedom in the model identification strategy restriction.[[1]](#footnote-1)

13.3 Method

We wish to test the relationship between choice and efficiency, where choice is a regressor for the efficiency level in an area.

Our basic framework is therefore

|  |  |
| --- | --- |
| $$E\_{i}=C\_{i}+ϵ\_{i}$$ |  |

where $E\_{i}$ is the efficiency level in area $i$ and $C\_{i}$ is the level of choice in this area. Since locational choice and efficiency are correlated, choice is not exogenous and therefore, must be instrumented to eliminate endogeneity which biases OLS estimators. Hence, we must use one of the methods discussed above (2SLS or GMM) for this purpose. Assume for simplicity’s sake that we have only one valid instrument, and that it produces unbiased OLS estimators. Alesina et al. (2004) recommend the use of a measure of ethnic diversity as an IV in similar frameworks as ours. Denote this variable of ethnic diversity as $S\_{i}$. We are now able to approach the first stage regression:

|  |  |
| --- | --- |
| $$C\_{i}=S\_{i}+ϵ\_{i}$$ |  |

The predicted values of choice from the first stage regression will now become our new choice variable $C\_{i}^{\*}$ as it is now not correlated with the error terms in the original model.

 We can now run the second stage OLS regression which will produce unbiased estimates.

|  |  |
| --- | --- |
| $$E\_{i}=βC\_{i}^{\*}+ε\_{i}$$ |  |

*13.3.1 Research Questions*

The research question of this work is:

Does locational choice positively affect efficiency?

However, if we find positive a relationship between choice and efficiency, in order to investigate whether our modified variables perform better than the traditional measures, we must examine the following hypotheses:

Hypothesis 1: Choice is positively related to efficiency when we use an index which includes rural and urban areas.

Hypothesis 2: The impact of choice on efficiency is better explained using efficiency index that accounts also to private expenditure on education. $E\_{i}^{1}$ can explain better than$ E\_{i}^{0}$ the relationship between choice and efficiency.

*13.3.2 Data*

In this section, we describe the variables used in this work along with the data sources from which these variables were constructed. We begin with an introductory description of the environmental characteristics of Israel and its public education system. Our work examines a snapshot of the Israeli education system in 2014 alone. Among the many distinctive demographic and cultural features Israel is known for, its public education system shares a wide variety of characteristics which are similar to the majority of OECD countries.

In the year 2014 in Israel, the population was close to 8.3 million, almost 80% of which were Jewish. 75% of this population resided in cities, while the rest lived in smaller, rural forms of localities. This work attempts to analyze the relationship between locational choice and efficiency in education in the country as a whole, and not just in urban areas. We begin by examining the geographical structure of Israel.

Israel has 1212 localities. 256 are municipalities out of which 249 were applicable for use (7 localities had missing values in more than a few variables). Out of the 249 municipalities, 76 are cities, 125 are local councils, and 48 are regional councils which unify the smaller localities. The Israeli Central Bureau of Statistics (CBS) has divided Israel into 52 “Natural Areas” (NA) which share geographical and other characteristics.

CBS Localities File (Central Bureau of Statistics, 2014) - Source 1 This publication includes physical data on population, education and welfare, infrastructure, etc., and financial data (budget implementation) in local authorities in Israel in 2014. The environmental variables from all localities were aggregated at the NA levels.

The variables include a description of the population features (for example, age composition, natural growth, ethnic background, etc.), data on geographical characteristics (distance from the center of the country, land area composition, land area of educational facilities, etc.), socio-economic variables (income, social welfare beneficiaries, percentage of workers with minimum wage, etc.), public education system characteristics (number of schools, number of classes, average number of students in a class, etc.), data on the budgets of localities (income and expenses, governmental transfers for the public education system, etc.)

**CBS costume made process file - Source 2** This file contains the averages of parental expenditure on private tutoring, for children who attend public schools. The source of the data is extracted from a nationwide survey which reviewed household consumer behavior. The data described averages for each NA.

**JavaScript Output - Source 3** To construct the choice variable of each NA, we designed a JavaScript that enabled the construction of sub-areas within each of the NAs (since localities differ in their size, defining each locality as a sub-area was not the correct practice in this case. Furthermore, parents from smaller villages send their children to study at nearby schools, therefore, we had to design a mechanism that would encompass these possibilities).

The script received the input of the geographical coordinates of the 1,212 localities and the population size of each locality. Each locality was assigned its NA. The script ran a loop which assigned a sub-area for localities with a population less than 2,000, if it had nearby localities within 250 meters of its given coordinates.

The sub-areas which the JavaScript created enabled the construction of the choice variable in the correct manner, and with the desired flexibility for the research needs. At this point, all the localities were in sub-areas, each of which was assigned to a NA.

|  |  |  |
| --- | --- | --- |
|  |  | Natural Area |
|  | Big or Medium Locality |
|  | Small Locality |
|  | Sub Area |

**Fig. 13.4** Geographic structure and legend

**Budget Transparency (Ministry of Education, n.d.) - Source 4** This source utilizes a downloadable dataset published by the Israeli Ministry of Education. The dataset details the budget allocated to each locality in Israel by the Ministry of Education.

*13.3.3 Variables*

Table 13.1 describes the sources of the variables used in the regressions. The calculation for the efficiency variables is described above in Eqs. 13.2 and 13.3. The calculation for the choice variables is described above in Eqs. 13.4 and 13.5.

**Table 13.1** Variables

| Variable name | Variable Description | Source |
| --- | --- | --- |
| Efficiency | Achievement: percentage of students who attained a matriculation diploma | CBS Localities File |
| Per student expenditure: ratio of the budget allocated by the Ministry of Education, and the number of students | Budget Transparency |
| Average parental expenditure on private tutoring | CBS costume made process file |
| Choice | Herfindahl population index calculated on sub-areas of Natural Areas | JavaScript Output |
| Herfindahl population index calculated on localities of Natural Areas | CBS Localities File |
| Herfindahl student enrollment index calculated on localities of Natural Areas | CBS Localities File |
| Simpson’s bio-diversity index | Calculated on Natural Areas using the data source “Shkifut” | Budget Transparency |
| Environmental variables | Includes socio-economic, demographic, and geographic variables. | CBS Localities File |

 The efficiency measures were created as described in Sec. 13.2.1 “Efficiency,” where achievement is measured using the percentage of the students entitled to full matriculation diplomas upon graduation in each locality. This percentage is taken from the localities file, and is calculated for each natural area with proportional weights given to each locality in accordance with the number of students.

Simpson’s bio-diversity index is calculated using the “Transparency” data on each locality’s ethnicities enrollment. The group identifiers were seven religious and ethnic groups:

|  |  |
| --- | --- |
| Jewish | 1. Secular
 |
| 1. Orthodox
 |
| 1. Ultra-Orthodox
 |
| Other | 1. Arab
 |
| 1. Druze
 |
| 1. Bedouin
 |
| 1. Circassians
 |

**Table 13.2** Group identifiers

These groups form the diversity of each area. An area which has only one ethnicity/group will have a zero Simpson’s index. The more groups with equal size in an area, the higher the value of its Simpson’s index.

13.4 Results

In this section, we describe the regression output of the GMM equations. We tested several specifications: the two efficiency measures (Eqs. 13.2 and 13.3) were tested against three measures of choice. The first (*Choice*) is the index created by the JavaScript, and two more indices (population = *Her\_Pop*, and student enrollment = *Her\_Stu*) which were computed on localities in NAs, where each locality is considered as a sub-area.

All models had the same instruments: Simpsons’ index, school transport driving costs in each NA, Movement – the difference between the inhabitants moving into and moving out of an NA, and the average income of citizens in the NA. Table 13.3 reports the results of our regressions.

Some explanations on the variables reported in Table 13.3: The variable *Choice1* is the choice variable produced by the JavaScript. *Choice2* and *Choice3* are Herfindahl indices produced by the population/student data of the CBS Localities File, calculated with the main areas and are the same natural areas as in the JavaScript, and the sub-areas are the localities themselves (not divided by the JavaScript as *Choice1*). The table reports GMM regressions on the two efficiency measures (as explained in Sec. 13.2.1 “Efficiency”), with the three regressors which measure choice. The reason we used these three regressors is that we wanted to test the choice index we designed against two other measures which were not created with the JavaScript to test its validity.

The variable *Area\_EDU* is the area size of each natural area which is dedicated to educational institutions. *Distance\_TA* is the distance from the biggest city in Israel - Tel-Aviv. *Ind\_teaching* is the amount of individual teaching hours dedicated to students in each natural area. *Peripheral* and *soci\_ind* are the averages of CBS indices for the level of periphery and the social index of localities within each natural area respectively.

**Table 13.3** GMM model results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Model | 1 | **2** | 3 | 4 | 5 | 6 |
|  | $$E\_{i}^{0}$$ | $$E\_{i}^{1}$$ | $$E\_{i}^{0}$$ | $$E\_{i}^{1}$$ | $$E\_{i}^{0}$$ | $$E\_{i}^{1}$$ |
| Choice1 | 19.3471 | 4.8231\* |  |  |  |  |
| (19.5367) | (2.1998) |  |  |  |  |
| Choice2 (Her\_Pop) |  |  | 9.1859 | 4.9397 |  |  |
|  |  | (6.5550) | (2.7299) |  |  |
| Choice3 (Her\_Stu) |  |  |  |  | 9.3372 | 5.9514 |
|  |  |  |  | (5.5210) | (3.4378) |
| Area\_EDU | -0.3085 | -0.1579\* | -0.1698 | -0.1354 | -0.1723\* | -0.1576 |
| (0.2898) | (0.0673) | (0.0949) | (0.0718) | (0.0826) | (0.0927) |
| DistanceTA | 0.0318 | 0.0095 | 0.0157 | 0.0103 | 0.0208 | 0.0163 |
| (0.0414) | (0.0063) | (0.0178) | (0.0101) | (0.0183) | (0.0137) |
| Ind\_teaching | 0.0045 | 0.0019 | 0.0012 | 0.0010 | 0.0017 | 0.0019 |
| (0.0055) | (0.0011) | (0.0031) | (0.0016) | (0.0030) | (0.0022) |
| Peripheral | 0.3781 | 0.1592 | 0.0177 | 0.0745 | 0.2226 | 0.2717 |
| (0.7445) | (0.1824) | (0.4653) | (0.2867) | (0.4999) | (0.3981) |
| Soci\_ind | 1.5086 | 0.5826\*\* | 0.8123 | 0.4487\* | 0.7582\* | 0.4496\* |
| (1.1655) | (0.1820) | (0.4280) | (0.2026) | (0.3823) | (0.2157) |
| N | 48 | 44 | 49 | 44 | 49 | 44 |
| R-Squared | - | 0.3111 | - | - | - | - |
| F-test | 10.70 | 70.49 | 25.05 | 24.93 | 25.56 | 18.59 |
| P-value | 0.7096 | 0.0000 | 0.0341 | 0.0353 | 0.0295 | 0.1811 |

Note. Standard errors in parentheses \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001.

In all models the choice variable was instrumented with Simpson’s index and the Movement variable.

A few environmental variables which were non-informative were omitted.

Table 13.3 shows that whenever we use the new efficiency variable $E\_{i}^{1}$ (regressions 2, 4, and 6), the coefficients of the choice variables are lower. In the case where choice is the JavaScript produced index (*Choice1*, regressions 1 and 2), the coefficient becomes significant at the 5% level, but it is much lower than the traditional efficiency estimate ($E\_{i}^{0}$).

Regression 2 is the only regression in which the coefficient of the choice variable is significant, and the *R-Squared* is significantly higher than zero. This regression has the highest *P-Value*. The JavaScript output (*Choice1*) produced the most valid results, although when the traditional efficiency measure was the dependent variable, its coefficient was higher than when used with $E\_{i}^{1}$.

 Table 13.3 confirms that our two main hypotheses were correct. It is indeed possible to analyze a country as a whole and to include urban and rural areas. Our model produces valid results and we were able to find a positive relationship between locational choice and efficiency.

Second, the parental (private) expenditure on private tutoring proved crucial to the validity of the model and the results. No choice variable was significant without this variable. A comparison between the traditional efficiency variable ($E\_{i}^{0}$) and the new one we suggest ($E\_{i}^{1}$) shows that whenever the parental expenditure is included, the coefficients of the choice variables become lower. This might imply that frameworks which do not include this variable may present biased coefficients (towards a higher impact of choice on efficiency).

Our model shows that the best choice indicator is our newly designed variable which was produced using the JavaScript. It was the only choice variable which produced a significant coefficient when run against the new efficiency indicator (Table 13.3, Column 2). Since this was a model which outperformed the others, we can begin interpreting the differences in the models.

13.5 Discussion

The importance of rectifying the question of whether and how choice affects the productivity of schools is self-evident (Abrams, 2016), and so is the challenge of examining the relationship between locational choice and efficiency. Up-to-date research is not clear about this empirical relation even though the theoretical prediction points to a positive relationship. The debate between Hoxby (2000, 2007) and Rothstein (2007) illustrates the ambiguity towards this relationship. While Hoxby finds a positive relationship, Rothstein finds that this relationship is rather small, if at all. This ambiguity is the motivational background behind this work.

The research question in this work, referring to the extent to which locational choice affects efficiency is extremely focused, however essential. Nonetheless, this work was structured in such a way that neither of the competing hypotheses tested (Hypotheses 1 and 2) was awarded favored treatment. This includes our newly tested measures; all were tested against traditional known measures, and results were reported and compared against each other. Moreover, this work includes a further leap in trying to investigate the relationship between choice and efficiency in a relatively small country such as Israel (which yielded only 50 areas suitable to be fragmented into sub-areas), without having access to special datasets and without dedicating much of this research resources to collecting data not found in previous studies other than the private expenditure on private tutoring. We further increased our mission task by requiring the inclusion of rural areas as well. Fortunately, our framework verifies Hypothesis 2 as well, and as a result there was no need to withdraw the restriction (of analyzing rural areas on top of urban areas) initially set in this study.

Several competitors to our newly designated choice variable were tested. The purpose of this comparison was to verify the validity of our choice variable, since no previous studies have used similar mechanisms for sub-area formation. In this work, a new choice variable was tested (*Choice1*). It performed extremely well, and we were able to present robust parameters solely after using this new choice variable.

The highlight of our framework is the new efficiency indicator, the importance of this variable has proved extremely high. As in the Choice variable, it was tested against traditional indicators which ignored the private expenditure on private tutoring, and the results showed that it was essential in producing a valid model which can link efficiency and choice.

In total, all our conjectures proved correct, and the model with our new choice variable and new efficiency variable performed better compared with all other competing models. Moreover, competing models were not able to verify Tiebout’s hypothesis in finding the link between efficiency and choice while our model with the newly defined variables produced robust results. Since this was the case, we are now prepared to discuss the policy implications of our framework.

Only when private expenditure on private tutoring was integrated into the efficiency variable could the model identify the relationship between efficiency and locational choice. This was the case despite the fact that rural areas were also included. This leads to the conclusion that the drawback in previous models was not the lack of valid instruments or alternatively, that rural areas were not included in the analysis. We propose otherwise, that the weakness in those models was that the information on private tutoring was not included.

We believe that the private expenditure on private tutoring is important and can alter the results, since this is how parents compensate for the low efficiency of public schools: they complement their offspring’s education themselves as a response to lower efficiency. This complementarity is achieved either by teaching their children themselves or by contracting a private tutor to do so[[2]](#footnote-2). Household income and other relative variables are controlled in the model, and since the addition of the private expenditure to the dependent variable’s denominator produced dramatic variations in the model’s results, it is reasonable to conclude that the contribution of this information to our framework was helpful.

With this information, we were able to reproduce Tiebout’s conjecture, i.e. that choice positively affects efficiency. However, with the use of the correct variables which validated the relationship between efficiency and choice came a dramatic decline in the coefficient of the choice variable. This decline in the value of the choice coefficient shows that whenever a correct specification is used to analyze the relationship between choice and efficiency, the effect of choice on efficiency is not as strong compared with competing models used in our study. In other words, while other models, used in this work, yield results that indicate a large impact of choice on efficiency, using a specification method rather indicates the positive impact of choice on efficiency is rather modest. This result of the low impact of choice on efficiency found in this research might occur as the information on private expenditure was included, compared with other models in the literature which did not account for private expenditure on education (Borland & Howsen, 1992; Hoxby, 2000).

Choice policies are aimed at creating a more competitive market, through which households are able to obtain better education (Betts & Loveless, 2005). The benefits of increased competition are said to be offset by factors such as sorting and declining equity (Ladd & Fiske, 2003). We believe that prior to a discussion on the tradeoff between the advantages and disadvantages of choice, its net effect on school performance must be indisputable. Therefore, the policy implications this study offers are that establishing reforms concerning the level of centralization of public education systems should use assessments of models which include all relevant information. Models which do not include all relevant information quite possibly might present biased results, such as a higher impact of choice on efficiency.

1. In 2SLS, the number of endogenous variables must equal the number of instruments, i.e. the model is exactly identified, while in GMM, this restriction is non-binding. [↑](#footnote-ref-1)
2. Bear in mind that the data on the expenditure on private tutoring was collected from interviews with parents and not from private tutors. Therefore, there is no reason to believe the data sets are biased. [↑](#footnote-ref-2)