ECONOMICS 333 (Urban Economics): July-August 2015 Syllabus

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Office Hours for Peter Tomlinson: Wednesdays 3:30 – 5:00 pm Innis College café. There may be occasional re-scheduling, in which case an announcement will be posted on the web site – check for announcements if making a special trip.

Term Test: (40 percent grade weight) will be held Thursday July 16 at 6:10 pm, Room 310 Exam Centre.

- Students who are ill on the day of the term test may be permitted to write a makeup test. In these cases, a U of T Medical Certificate will be required to document the illness. The certificate must be fully completed by an MD, with the doctor's OHIP registration number indicated. The certificate must also indicate that the doctor examined the student on the day of the term test. Only original certificates (i.e. not photocopied or scanned) will be accepted.

- Medical certificates should be submitted at the makeup test. They should not be submitted to Economics Department staff or to me before then.

- Students missing both a term test and the makeup will receive a zero grade on that part of their term work. There is no right to a second makeup. Requests to undertake an alternative form of term work will not be considered. Likewise, requests to shift the term-test grade weight to the final exam will not be considered.

Homework Assignment (10 percent grade weight). Due August 4 in class. Any late submissions will be accepted with a 2-mark penalty until the start of class (6:10pm) August 6. Details of required work will be provided on Portal by July 20. Students can collaborate when working on the assignment, but each student must write his or her answer independently.

Final Exam (50 % grade weight). The final exam will be held during the August exam period, in accordance with Faculty regulations for final exams.

Course Content A week-by-week summary of material covered in class follows below. Required readings are from the text (Arthur O'Sullivan's "Urban Economics", 8th edition), and from course notes posted on Course Documents (Portal Site).

Until July 24 we will explore selected urban models in depth. These models have points of departure in the text, but most of the analysis is outlined in the course notes. After July 24, we will survey major topics in urban economics, relying primarily on chapters in the text.

June 30-July 2: Simplified Land Market Models

Land Used for Manufacturing

Readings: Arthur O'Sullivan "Urban Economics" [1] pages 128-30. "Introductory Notes on Rectangular Land Market Model", posted on Course Documents.

[1] Referred to below as the "textbook". Page numbers cited here apply to the eighth edition. If requested, an announcement on the Portal site will note equivalent page numbers in the sixth and seventh editions.

Because land is an immobile input into production, its price will not necessarily be the same at different locations. (Land obviously can't be moved from a low-rent location to a high-rent location.) In competitive equilibrium, firms renting land at each location earn only the profit required to keep them in business ("zero-economic-profit" condition). The manufacturing model in O'Sullivan's text has firms' freight cost increasing with distance from a highway. Equilibrium land rent will then decrease with distance from the highway – as required to maintain zero-economic-profit equilibrium at all locations.

Boundaries for the rectangular land market are specified: highway on the west, zoning boundaries on the north and south. Equations for manufacturing bid rent and output supply (marginal cost) functions are derived from exogenous variables in the model. The equations can be used to determine equilibrium values for endogenous variables (initially, land rent at each location and total manufacturing output). A second industry (agriculture, assumed to have an exogenous land rent) is introduced to compete with manufacturing for land. Land owners allocate land to the highest bidder – manufacturing firms at some locations, farms at other locations. The endogenous boundary between manufacturing and agricultural land is the market-determined "city limit" (Figure 1 in Notes).

Figure 2 in the Notes shows the impact on the output supply function of changing the land supply. Because city-controlled zoning lines form the rectangular land market's northern and southern boundaries, these boundaries can be moved farther apart or closer together. Moving them farther apart expands the land supply – at each distance from the highway – making the output supply function more elastic. Conversely, moving them closer together restricts the land supply, making the output supply function less elastic. Supply-side changes in the land market change equilibrium values of endogenous variables – at this point still just manufacturing land rents, output and the city limit location.

Figure 3 in the Notes adds an endogenous output price to the model, with the model now determining equilibrium simultaneously in land and output markets. The output price, initially assumed exogenous, is now an endogenous variable determined in the model.

Figure 4 allocates total revenue received by firms in the model among the various cost components. The zero-economic-profit equilibrium condition for a competitive industry requires distribution of all revenue to the inputs employed in production. Payment to the land input is divided into (1) a component covering the opportunity cost of land (i.e. what manufacturing firms must pay to bid land away from agriculture); and (2) a residual component (required to make economic profit = zero at all locations). Only the opportunity cost component is included in the output supply function, thus affecting equilibrium output price. The residual component is not a variable in the output supply function, so it does not affect equilibrium output price.

Rezoning to allow only manufacturing in the rectangular land market is considered in Figure 5. This change eliminates the opportunity cost of land. Rent paid to land owners is now entirely a zero-economic-profit residual. In this case, land rent has no effect on the output supply curve, and thus does not affect equilibrium output price. Note, however, that the exogenous land-supply variable y, determined by the city, is included in the supply function equation so it does affect output price.

Land Used for Housing

Readings: Textbook, pages 139-45, 156-158. Notes entitled "Urban Land Markets with Factor Substitution", posted on Course Documents, pages 5-6.

So far, the land-market model has included only manufacturing and agricultural land. Residential land must be added to complete the model. Residential land is land on which housing firms outbid manufacturing firms and farms. Housing firms rent housing to residents, who supply labour to manufacturing firms – commuting to those firms from locations in the residential area. While housing firms are residents' landlords, these firms are tenants in the land market: they pay rent to land owners for the land under their buildings. Residents are assumed identical, with an exogenous utility level determined outside the model – the "open-city" assumption, which requires costless mobility in and out of the model city. (A fixed utility level is available in cities outside the model.) For simplicity, an exogenous wage is assumed, with the further simplifying assumption that all manufacturing firms are located at the land-market's far western edge (x = 0). An indifference-curve / budget-line diagram is used to determine equilibrium housing consumption, equilibrium non-housing goods consumption, and equilibrium housing prices at each residential location.

Housing firms in the model face an equilibrium housing price function, as required to provide residents with equilibrium utility at each location in the residential area. Commuting cost increases with distance from x = 0, so the housing price decreases with distance x. The housing price function can be specified either with consumer substitution (all combinations of housing and non-housing goods consumption are available), or without consumer substitution (only one combination providing equilibrium utility is available). Housing firms must earn zero economic profit in equilibrium, and this condition is used to derive bid rent functions for housing firms. Since housing firms renting to residents with relatively high commuting cost face a relatively low housing price, the residential bid rent function is negatively sloped in relation to commuting distance.

July 7-9: Land Markets with Factor Substitution

Low-rise and high-rise buildings

Readings: Textbook, pages 134-139, 150-160; Notes entitled "Urban Land Markets with Factor Substitution", posted on Course Documents.

In land-market models as specified to this point, inputs employed by each firm are assumed exogenous. More realistically, however, a firm's land input will be endogenous, with firms at high-rent locations using less land than firms at low-rent locations. The textbook develops a model with firms that build office buildings in which their final output – an information product of some kind – is produced. For convenience, only two inputs are assumed necessary for an office building: land and capital. All firms are assumed to require buildings with the same total floor area. A firm's land input consists of land under the building, so the smaller a firm's land input the smaller will be the area of each floor – and thus more floors (i.e. taller buildings) are required to attain the required total floor area. Taller buildings require relatively more capital, in the form of structural reinforcement, high-speed elevators etc. "Factor substitution" in this context refers to firms' ability to substitute capital and land inputs, thus constructing office buildings of varying heights.

Firms in the factor substitution model considered here require raw information to produce an information product they can sell. The cost of obtaining raw information increases with distance from a preferred location (called the "median location"). Maintaining zero-economic-profit equilibrium means that firms far from the median location must spend less on land and capital for their building than firms close to the median location. A unique value for total spending on land and capital is thus associated with each value of the distance variable (x). An isoquant / isocost diagram is used to determine equilibrium land and capital inputs at various locations in the land market. Land inputs determine building heights, with taller buildings constructed close to the median location. The land market in this model is circular rather than rectangular, with the median location at the centre. For convenience, the model assumes an exogenous output price; also for convenience, residential land is excluded from the model.

Zoning can be used to switch factor substitution on or off. For example, zoning can require buildings of a specified height, thus implicitly specifying a mandatory land input. With factor substitution switched off, the equilibrium bid rent function (i.e. land rent as a function of distance from the median location) is linear if the cost of obtaining raw information (called "travel cost" in the textbook) increases linearly with distance. Conversely if factor substitution is switched on, again with travel cost increasing linearly with distance, the bid rent function is convex (viewed from below). Other possibilities for the bid rent function's shape are considered, with travel cost increasing either at an increasing or decreasing rate, and with factor substitution switched on or off.

Mathematical Version of the Factor Substitution Model; Land and Capital Taxation in the Factor Substitution Model

Readings: Notes entitled "Factor Substitution Mathematical Model", posted on Course Documents. Notes entitled "Taxes in Factor Substitution Model", posted on Course Documents.

Mathematical Model: A Cobb-Douglas production function for production of floor space in an office building is specified. An equation for the isoquant corresponding to firms' required floor space is derived from the production function. A linear function relating travel cost to distance from the median location is also specified. It is then possible to solve for land rents and building heights at various locations in the model.

Taxation: The factor substitution model can be used to show adjustment to a tax on land rents: with this tax, there is no change to either land or capital inputs of firms, and no change to total output produced on the fixed land supply at any given location. Conversely, a tax on firms' capital input causes the fixed land supply at any given location to be occupied by fewer firms – each firm will use more land and less capital when the capital tax is in effect. Given the model's assumption of exogenous output per firm, total output produced on land at a given location must be reduced when a capital tax reduces the number of firms at that location.

July 14-16: Introduction to Urban Public Finance Model

Local Public Goods

Readings: Textbook, pages 412-417.

The focus here is on a key economic role of local governments: residents establish these governments to provide local public goods. Taxation is required to finance production of public goods because the voluntary payment mechanism applicable to private goods is not applicable to public goods. Firms producing a private good provide it to those willing to pay, while others not willing to pay are excluded from consumption. In the case of a public good, no resident of a town will be excluded from consumption. If payment for the good were voluntary, residents would be motivated not to pay: their consumption would be the same whether they paid or not. Taxation resolves that problem. Non-rival consumption is a related feature of public goods. If a town has a 10-acre park, all residents of the town derive the utility associated with 10-acre park consumption. Depending on the tax system in place, some residents would be willing to pay higher taxes in exchange for a larger park, while others would be better off with lower taxes and a smaller park. With private goods, residents can choose the consumption level they are willing to pay for, so consumption levels will vary from resident to resident. In the case of public goods, residents of a town cannot individually vary their consumption levels.

The efficient consumption level is determined in a model developed by Paul Samuelson. Efficiency in this context means that total utility of town residents (as a group) is maximized. As Samuelson pointed out, non-observable information (the public good's "marginal benefit" function for each resident) must be known in order to locate the efficient consumption level. With an unknowable efficient consumption level, there is no way of determining whether the equilibrium consumption level is efficient or not. We use the median voter model to determine the equilibrium consumption level, on the assumption that a head tax is used. A head tax divides the town's cost of producing public goods equally among residents. Apart from the median voter, whose utility is maximized, residents are dissatisfied – in some cases because they regard the equilibrium consumption level as too high, in other cases because they regard it as too low. A model known as the Lindahl benefit-tax model proposed replacing the head tax with a tax that motivates residents to vote for an efficient equilibrium consumption level. However, Lindahl's tax system taxes residents based on voluntarily disclosed information regarding their marginal benefit functions. Given the town's inability to verify the information that residents provide, residents are motivated to understate marginal benefit functions – doing so will reduce their tax payments.

The Tiebout Model

Readings: "Notes on Urban Public Finance" posted on Course Documents, pages 1-12.

Charles Tiebout noted that if every resident of a town has the same marginal benefit function, they will vote unanimously for an efficient public-good consumption level – given use of a head tax. Since a unanimously preferred consumption level will obviously be the equilibrium level, equilibrium will be efficient. Tiebout also noted that if there are many towns in a metropolitan area, residents are motivated to move to a town providing their preferred consumption level, thus avoiding the disutility associated with a town ruled by a dissimilar median voter. Thus Tiebout's model has a metro area in which residents of each town have the same public-good preferences and in which efficient consumption levels result from town residents' unanimity. For example, residents preferring a high public-good consumption level, and who are willing to pay the taxes required for that consumption level, can move to a town giving them what they want – an outcome comparable to choosing a high private good consumption level when a resident is willing to pay for it.

As population of a Tiebout town increases, costs of producing public goods are divided among more residents. "Taxpayer surplus" – a dollar measure of utility residents derive from public good consumption net of tax payments – is thereby increased. "Congestion cost" is a dollar measure of the disutility residents experience if their utility is negatively affected by an increase in the number of residents. At relatively low population levels, congestion cost is zero when the number of residents is increased. However, as the number of residents continues going up, congestion cost is experienced, increasing with population at an increasing rate. For example, congestion cost associated with park consumption will eventually increase as the park becomes more crowded. The efficient population is reached when the marginal increase in congestion cost equals the marginal increase in taxpayer surplus.

<u>July 21-23 Extensions of the Urban Public Finance Model</u>

<u>Scale Economies and Spillovers: Potential Rationales for Consolidation of Tiebout Towns</u>

<u>Readings</u>: Textbook, pages 421-422; "Notes on Urban Public Finance", pages 12-20.

What if the number of metro-area residents having the same preference for public goods exceeds the efficient population for a Tiebout town? There are two possible solutions: (1) provide these residents with more than one town, each town having the efficient population; or (2) create a consolidated town with multiple communities, each having the efficient number of residents, and with public goods provided separately to each community – for example each community would have its own park. If production of public goods is subject to constant cost, either solution is equally efficient. However, scale economies can make the consolidated town more efficient than separate towns. "Spillovers" occur when residents of a town obtain utility from public goods provided in another town – where they do not vote and pay taxes. In this case, residents of independent towns are motivated to vote for inefficient consumption levels. However, if the towns are consolidated, residents will vote for an equalized consumption level in each community. It won't matter whether they obtain all their utility from public goods in their own community or from public goods in other communities as well – voting can be efficient either way. Thus if spillovers exist with independent Tiebout towns, consolidation to eliminate the spillovers can increase residents' utility.

<u>The Tiebout Model With a Property Tax Replacing the Head Tax; Natural Monopoly</u>

<u>Readings</u>: Textbook, pages 442- 443 for property tax; pages 417-419 for natural monopoly. "Notes on Urban Public Finance" pages 20-22.

<u>Property Tax</u>: Bruce Hamilton modified the Tiebout model by introducing a property tax to replace Tiebout's head tax. Head taxes are not widely used, whereas property taxes are used by most (if not all) local governments in North America. We begin the analysis with a Tiebout town using a head tax. Residents have homes with different market values, but these differences are irrelevant with the head tax. They vote unanimously for the efficient public-good consumption level. We then switch to a property tax. The tax price paid by residents with homes of above-average value goes up. The tax price paid by residents with homes of below-average value goes down. Unanimous voting has been disrupted by the change to the tax system, so equilibrium consumption is now determined by the median voter. There is no reason to expect the equilibrium consumption level to be efficient. Assuming an exogenous utility level available in other towns, the value of homes with above-average value will be lower than with the head tax but still above average – an impact referred to as "capitalization". In Hamilton's version of the Tiebout model, residents with homes of above-average value are motivated to establish towns that exclude lower-value homes via zoning. In a town with every home having the same market value, there is no difference between a property tax and a head tax. Efficient equilibrium is just as achievable with a property tax in such a town as with a head tax.

Natural Monopoly: Some goods have private-good characteristics of excludability and rival consumption, but local governments produce them anyway. Purified municipal water is an example. A rationale for municipal production is that competition may be ruled out with private-sector production. An average cost curve that declines with output over the relevant output range makes average cost lower if there is only one firm, compared with average cost if production is divided up among a number of firms. Protected from competition by this "natural monopoly" condition, a single firm can charge a monopoly price. This result can be avoided if the town takes over production and charges an efficient (marginal cost) price. Alternatively, the town can allow production by a monopoly private firm, with its price regulated at the efficient marginal-cost level. In either case, revenue from consumers will not cover costs since marginal cost is below average cost when average cost decreases with output. If marginal cost pricing is preferred to average-cost pricing, it will be necessary to finance part of the cost with a user price unrelated to consumption, or else provide a subsidy from tax revenue.

July 28-30: Urban Growth Models, Agglomeration Economies and Related Topics

Readings: Text, Chapters 1-5.

Chapters 1-5 do not require notes like those posted on Course Documents — notes written to drill down into models outlined briefly in the text book. (The content summaries for previous weeks, as seen above, indicate how Course Document notes relate to relevant discussion in the text.) Some content in Chapters 1-5, noted below, is optional reading (i.e. interesting but non-mandatory, meaning excluded from exam content).

In Chapter 1, content dealing with American census definitions is optional (p.3 and entire Chapter 1 appendix).

In Chapter 2, the section headed "Trading Cities in Urban History" is optional (pp. 20-22); also the section headed "The Industrial Revolution and Factory Cities" is optional (pp. 24-27).

In Chapter 3, statistical data regarding clusters is optional (pp. 46-47); also the sections headed "Labor Matching", "Knowledge Spillovers", and "Evidence of Localization Economies" are optional (pp. 55-60); also the section headed "Other Benefits of Urban Size" is optional (pp.62-64).

In Chapter 4, the section headed "Specialized and Diverse Cities" is optional (pp. 76-78); also the sub-section headed "Urban Giants: the Puzzle of Large Primary Cities" is optional (pp. 82-83).

August 4-6: Urban Transportation

Readings: Text, Chapter 10 (the original edition of this outline also included Chapter 11 but that chapter is no longer mandatory reading).

As with Chapters 1-5 the content of Chapter 10 does not require notes posted on Course Documents. Some material in Chapter 10 is optional reading (i.e. interesting but non-mandatory, meaning excluded from exam content), specifically:

The US statistical data on commuting is optional (pp. 257-260); also the sub-section entitled "Congestion Taxes and Urban Growth" is optional (pages 266-7); also the section headed "Automobiles and Poverty" is optional (pages 283-4).