METROPOLITAN COUNCIL'S PRELIMINARY FORECASTS METHODOLOGY

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METROPOLITAN COUNCIL

Metropolitan Council's Preliminary Forecasts Methodology

Long-range forecasts at Metropolitan Council are updated at least once per decade. Population, households and employment levels are projected with a 30-year time horizon. The regional and local forecasts express future expectations based on an understanding of regional dynamics, and representing expected outcomes of policies and planning. Consistent with *Minnesota Statutes* 473.146 and 473.859, these forecasts provide a shared foundation for coordinated, comprehensive planning by the Council and local governments.

A preliminary regional forecast was presented at Metropolitan Council's Committee of the Whole on April 18, 2012. Preliminary local forecasts were issued on September 11, 2013. The ultimate results of this project – a final regional forecast, together with local forecasts – will be included in the *Thrive MSP 2040* plan for Council approval in April 2014.

Overview of forecasting project.

Metropolitan Council's long-term forecasting is premised on understanding the Twin Cities' situation within the larger, national economy: The region's business conditions and competitive advantages determine regional economic and employment levels, which in turn prompt population growth through migration.

Subsequent to the *regional* forecast, *local* forecasts address geographic distributions within the region. Regional population, households and employment will site in specific places. Metropolitan Council assumes that real estate demand and supply dynamics, interacting with future transportation accessibility, primarily determine outcomes, influenced by regional land use policies and local plans.

Considering the multi-scale nature of future planning needs, Metropolitan Council employs multiple forecast modeling tools:

- A regional economic model for forecasting region-level economic activity and migration flows in response to economic opportunity.
- A demographic model packaging population forecasts into various household types
- A land use model simulating and projecting real estate market dynamics, in order to locate future land use, households and employment to communities and zones.

Methodology of REMI PI.

In 2011, following a review of best practices in regional economic modeling, the Council selected REMI PI as the model best fitting the Council's understanding of regional growth. REMI PI is a structural macroeconomic simulation model. It makes use of computable general equilibrium (CGE) techniques for simultaneous solution of macroeconomic accounts, as well as input-output matrices to represent inter-industry flows and impacts. Also, the model employs new economic geography techniques to represent regional differentials and aggregated interactions among regions, mainly trade and migration flows.

Simulation and projection of economic activities (production, consumption, and trade) are central to the model; Cobb-Douglass functions determine the balance of capital, and labor levels; and the model seeks equilibrium between industries' labor demand, wage levels, and labor supply. If industries' labor demand intensifies (or slackens), then wages and labor supply adjust up (or down) via economic migration. Thus, economic competitiveness and labor demand are the major determinants of migration in the REMI PI model.

A more detailed description can be found in the model documentation:
Regional Economic Models Inc. (2013), *REMI PI+ Model Equations*, online at
www.remi.com/download/documentation/pi+/pi+_version_1.5/PI+_v1.5_Model_Equations.pdf

Our Minnesota implementation of the model has two *home regions*: the Twin Cities metro is one; the remaining 80 counties are a second region; the rest of the nation and the world are additional linked economies. Model updates delivered by Regional Economic Models Inc. in 2011, 2012 and 2013 assess the Twin Cities metro having factor cost advantages, resource advantages, and good workforce availability across a complete range of occupations. These characteristics inform a forecast of above-average growth in coming decades.

Methodology of Profamy model.

Metropolitan Council has also implemented Profamy, a separate demographic model for projecting household counts by demographic cohort, using extended cohort-component techniques to represent household change dynamics.

The model groups all population members by age, race and gender, and projects forward distributions of life cycle states based on demographic schedule probabilities. These schedules cover fertility rates, survival rates, leave home rates, inter-regional migration, household formation, and cohabit/marriage/separation rates. Summarization of probabilities provides a comprehensive time-series of population and households characteristics.

A more detailed description is available from the model developers. See:
Yi Zeng, et al. (2010), *Household and population projections at sub-national levels: An extended cohort-component approach*, online at *http://paa2010.princeton.edu/papers/101958*

In 2012, Metropolitan Council staff worked with HCF Consulting to update the model with region-specific 2010 base year data, region-specific fertility rates, and migration rates by age, race and gender. The migration rates table is a compilation of migration results from the REMI PI model. Profamy was tested by Council staff and its projections compared with the REMI PI forecast. Given the same demographic schedules, and the exogenously-provided migration rates, Profamy can produce a 30-year-horizon population projection that is within 1 percent of the REMI PI forecast.

Metropolitan Council staff are using REMI PI for economic, employment and population forecasts. Profamy is used as a follow-on process, to parse the REMI PI population projections into households by household type. HCF Consulting has provided programming that allows the model user to enforce consistency with the time-series of population projections received from the REMI PI modeling.

Modifications to the as-delivered REMI PI model.

In the implementation of REMI PI, Council staff modify some settings and data inputs to the model. First, the national forecast in the Council's model is controlled to match nation-level GDP projections and industry employment projections drawn from Global Insight's 30-year Trend forecast; this is the same forecast used by the Minnesota State Economist as a baseline for long-term, national economic

expectations. The national forecast is significant insofar as the Twin Cities metro and Minnesota are part of nation, and the region's economic growth is tethered to national economic conditions. For more information, see:
Minnesota Management & Budget (2012, and updated bi-annually), *Economic & Minnesota Outlook*, online at *www.mmb.state.mn.us/feb-2013-forecast*

Second, Council staff update regional time-series tables with known numbers and facts on the ground:

- 2011-2012 regional population by race and age are updated with estimates by US Census Bureau;
- 2011-2012 regional industry employment are updated with counts from Minnesota Department of Employment and Economic Development statistics.

A number of future expectations are adjusted to better reflect regional trends. There are variables in the model that are recognized as difficult to project. Generally, Council staff assumes a stable status quo or median values within the range of possibilities:

- REMI's fertility rates schedules (fertility rates by race and by age of mother) are replaced with region-specific projections prepared by Council staff. In the Twin Cities metro, Council staff project the region's total fertility rate for whites increases to 1.78 per woman; the rate for blacks declines to 2.89; rates for Hispanic, Asian, and other race groups remain stable at 2.38.
- REMI's survival rates schedules are adjusted to better match the Minnesota State Demographer's. The State Demographer projects, conservatively, that life expectancies advance by 2 years over the 30-year projections horizon.
- College-going population by race is projected to increase in tandem with growth in the resident population of 17-year-olds by race.
- Average property tax rates for the Twin Cities metro are updated to reflect tax increases during 2011-2013, and are projected to level off thereafter.
- Consumer prices for energy are adjusted to maintain a constant ratio of regional prices relative to national average prices. Utility rates are held at 95 percent of the national average; fuel prices are held at 100 percent of the national average; there is not clear reason to project that Twin Cities metro relative prices would decline below these relative levels.

The forecast models described above provide details on future demographics and industry composition at a macro-level, without geographic detail. Additional modeling, at a local scale, is necessary to project the geographic distribution of households and industries over time.

Methodology of Cube Land.

In 2009, Council staff conducted an internal needs assessment and a state-of-the-practice review of land use models. Council staff recommended adoption of a market simulation model capable of producing zonal projections of households, population and employment, as well as accounting future land use. In 2010, the Council licensed and implemented Citilabs Cube Land as a platform for local real estate market modeling and scenarios analysis. Cube Land was chosen in part for its potential to integrate with the Council's travel demand model, allowing land use patterns and transportation network conditions to iteratively adjust over time.

The logic of Cube Land is the market sorting and equilibriation of real estate demand and supply (real estate types and locations), assuming best-use and value-maximizing decisions of households, site selectors and developers. Cube Land includes three submodels:

- The *demand submodel* simulates an auction in which different market segments are willing to pay (or bid) differential amounts for combinations of real estate and place characteristics.

- The *rent submodel* uses estimated bids, along with other local characteristics, to estimate rents for different real estate types at specific locations.
- The *supply submodel* projects forward real estate development by comparing rents with supply costs, and locating new development based on estimated profit margins (rent minus supply costs) and land supply availability.

In summary, households and worksites choose real estate types, situated in specific locations, so as to maximize value. Developers respond by supplying real estate responsive to the demand.

The demand model mathematically represents the preference structures of different household market segments and industry sectors using variables, and parameters for variables, identified and estimated through discrete choice analysis of existing behavior (which is known through survey data). Variables include neighborhood characteristics and accessibility to destinations. These quantified preferences allow the model to estimate probabilities of all potential real estate choices for each defined household type and worksite type. The choice is comprised of realestate types and locations. The locations correspond to the post-2000 Transportation Analysis Zone (TAZ) system used in the Council's travel demand model.

Many of the variables that determine the choice probabilities can change over time: Summarized land use and remaining available land supply, industry mix, and socioeconomic mix of zones are projected and updated within the model. Accessibility measures are projected and updated through iterative looping with a linked travel demand model.

Concurrently, the rent model uses estimated bids, as well as other zonal characteristics, to calculate and update rents within the model. If real estate in a certain location is highly desirable to one or more market segments, rents can change, altering estimated distributions (or probabilities) of household and worksite location choices, and prompting choice substitution. Ultimately, the model seeks an equilibrium solution where all forecasted future households and employment are sorted into real estate choices, proportionate to updated choice probabilities.

The discussion above concerns different market sectors valuing locations, and sorting themselves to accomplish best-value results. Importantly, Cube Land allows supply response to growing and changing market demand. Regional totals of target-year households and employment can differ from start-year totals. To accommodate growth in households and employment – which has been forecasted using the region-level forecast models – the Cube Land supply submodel projects the addition of new housing and employment-bearing built space. In the Twin Cities implementation of Cube Land, the major determinants of such development are land supply and estimated rents for each zonal location. As rents are dynamically estimated within the model, the geographic distribution of new development is likewise dynamic – with new growth precipitated by lower development costs and/or higher rents for valued location characteristics.

Data and Variables Used in the Council's Cube Land Modeling

The Twin Cities implementation of Cube Land segments worksites and employment into 8 industry sectors; these groups have varying preferences and use varying amounts of 5 types of employment-bearing real estate. Households are segmented by socioeconomic characteristics into 5 major household types (and 80 subtypes), which then select housing from 8 housing types. This segmentation enables moderate representation of how real estate and location preferences vary among different household and industry types.

The Cube Land system allows flexibility in defining the set of variables that comprise preferences and valuations of real estate. The variables identified as most significant, and included in the Council's modeling, are compiled for 1,201 Transportation Analysis Zones. These zonal characteristics also inform the calibration of the model to year 2010 conditions. Zonal characteristics include:

- Real Estate Characteristics:
  - Start-year land use mix and undeveloped land supply
  - Existing housing stock and employment-bearing built space
  - Average land consumption per real estate unit
  - Average building costs

- Surrounding Land Uses:
  - Proximity to lakes and rivers
  - Zonal demographics
  - Zonal employment
  - Housing density

- Regional Systems and Services:
  - Proximity to parks
  - Wastewater service availability
  - High frequency bus stops
  - LRT stations

- Transportation Accessibility, obtained through interaction with the Council's travel demand model:
  - Number of jobs within 20-minute travel time (by automobile and by transit)
  - Number of households within 20-minute travel time (by automobile and by transit)

The Cube Land model also uses local planned land use and regional policies when forecasting future real estate supply, including:

- Planned Land Use acreage (from local comprehensive plans)
- Allowable real estate types
- Existing housing densities
- Maximum allowable housing densities (from local comprehensive plans)
- Maximum allowable housing units (from local comprehensive plans)

In summary, the Cube Land model is richly informed about base year conditions and the envelope of future possibilities.

Model maintenance and forecast updates.

Metropolitan Council receives annual updates of the REMI PI software and time-series data inputs. The model received in July 2013 includes time-series data for years 1990-2011, as well as national demographic adjustments to reflect US Census Bureau's immigration assumptions. For more information, see:
US Census Bureau (2012), *2012 National Population Projections*, online at
www.census.gov/population/projections/data/national/2012.html

Council staff will prepare final regional and local forecasts in early 2014, for approval by Metropolitan Council and inclusion in the *Thrive MSP 2040* plan. These final forecasts will reflect updated data and assumptions, and updated representation of regional policies.

In the preliminary forecast modeling, geographic representation of regional systems and policies has been limited to a base-case scenario, including: the 2030 Metropolitan Urban Services Area, defining the coverage of wastewater service; the 2040 regional transportation network, incorporating the planned, long-term program of transitways and highway improvements to 2040; and local comprehensive plans prepared by communities during 2005-2011, with planned land use to 2030.

Revisions of these systems and policies are possible and can be represented in updated local forecasts for the *Thrive MSP 2040* plan, or in subsequent updates coordinated with regional system plans. The preliminary modeling does *not* presently account for – but could be modified to represent – new policy factors. Hypothetically, these could include real estate development responding to subsidies for affordable housing development, added development costs in subregional areas with water supply limitations, or maximum capacity restrictions in such areas.

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