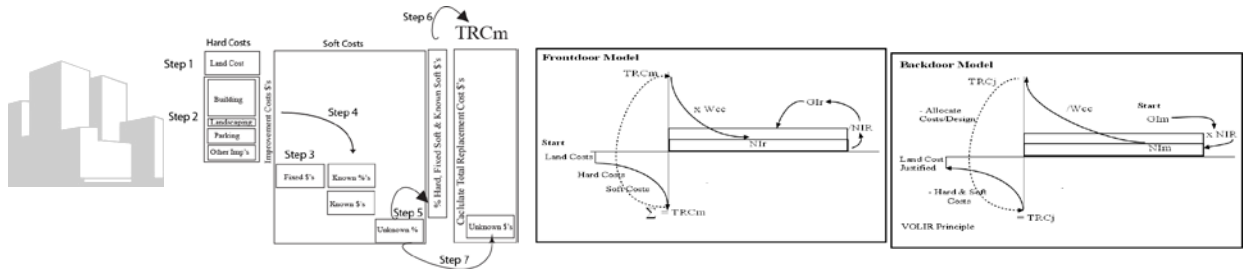


Case 3: Frontdoor/Backdoor Analysis

Jim DeLisle/Rebecca Griego

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Objective

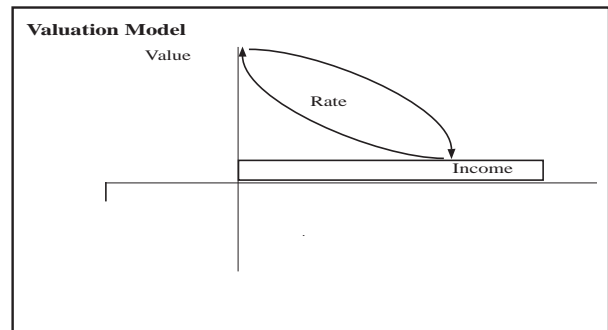
In Case 1, we calculated the maximum building envelope (Bmax) that would fit on a site under existing zoning restrictions. These calculations were based on zoning codes and parking requirements which placed a constraint on the maximum size of a building that could be placed on a given site. In Case 2, we explored how the market-based Total Replacement Cost (TRC_m) for the proposed development can be calculated. In this case, we will explore some basic financial elements of the proposed development, covering both the Frontdoor and Backdoor models. In essence, the two models explore a project from different perspectives: the Frontdoor solves for the Gross Income required (GI_r); and, the Backdoor solves for the Total Replacement Cost Justified (TRC_j).

- **Frontdoor Analysis.** This model is designed to calculate the rent required to provide an adequate return to support the TRC_m for a specified development. In addition to the Gross Income required, the model also establishes the rental structure which reflects differential pricing for the various rental components.
- **Backdoor Analysis.** This model is used to back into the Total Replacement Cost Justified (TRC_j) for a project in light of the Gross Income in the market (GI_m) that it is likely to generate. In essence, the model begins with the most likely tenant or user, backs into the budget they are willing and/or able to allocate to real estate, and then establishes the TRC that is “justified” by that income in light of other expenses and return requirements for the various sources of capital.

Background

Exhibit I presents the basic valuation model for real estate. At a simple level, the analysis focuses on three variables: Value, Rate and Cost. The fundamental equation consists of $V = I/R$.

Exhibit 1: Basic Valuation Model



In the basic valuation model, the components include:

- **V = Value of the asset.** In our analysis, the term is also referred to as the Total Replacement Cost (TRC) for a project.
- **R = Rate of Return on Investment.** In real estate, this Rate can refer to a number of return measures, ranging from an overall rate of return, to an Internal Rate of Return or Weighted Cost of Capital. The latter refers to a blended rate that combines the mortgage and equity return requirements into a combined rate.
- **I = Income from Rental.** In general, this is the Net Income figure which is the amount that is left to compensate capital providers, both debt and equity, in a particular project after operating expenses and other claims.

Application. The equation $V = I/R$ can be algebraically manipulated to isolate any one of the three variables. That is, the analyst can solve for the Value supported by a given level of Income with a required rate of Return. Alternatively, the Return can be calculated by dividing the Income generated by a project by the Value or cost at which it is acquired or produced.

- In the Frontdoor Model, the analyst solves for the Income required $V \cdot R = I$.
- In the Backdoor Model, the analyst backs into the Value or cost that can be supported by capitalizing the Income by a rate of return (i.e., $V = I/R$).

It should be noted that these basic variables can be modified to accommodate a range of more detailed and/or complex analysis. The analysis is designed to provide a “starting point” or filtering analysis used in comparing investment alternatives or providing a preliminary test of the feasibility of a project. It is a simplified approach which ignores Time Value of Money and treats the income/receipts as annuitized payments in perpetuity. Despite this limitation, the approach is fairly robust and provides a valid starting point for more advanced investment modeling including Discounted Cash Flow analysis. In essence, if a project pencils out with the Frontdoor/Backdoor models, under normal conditions it will work on more advanced calculations.

Terminology. The Frontdoor and Backdoor models use the same basic syntax, with some minor adjustments to indicate whether they are dependent or independent variables in the particular phase of analysis. The common elements include:

- **NIR.** This is the Net Income Ratio which is the relationship between Net Income and Gross Income (i.e., NI/GI). The differences between the two types of income include deductions or allowances for:
 - **Expenses.** These are the operating
 - **Vacancy Allowance.** These items are not actual expenses, but are
 - **Property Taxes.** This is the

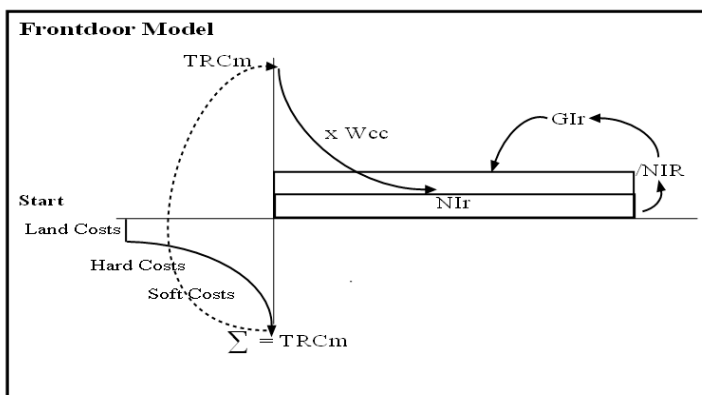
- **Reserves.** This is an optional item that can be used to establish a reserve fund for maintenance and repairs not included in the core operating expenses.
- **Wcc.** This is the acronym for the Weighted Cost of Capital. It is derived through an equation which blends the cost or rate on the mortgage with the cost or rate on the equity using the Loan-to-Value (LV) ratio as the allocation. The Wcc equation is:
 - **Where:**
 - **LV.** The percent of the initial value provided by the permanent lender.
 - **Mc.** The Mortgage Coefficient or constant payment which provides a blended payment of interest and principal which will amortize or retire the principal balance over the amortization period.
 - **Term.** This is the number of years over which the mortgage is amortized.
 - **Periodicity.** This is the number of periods per year over which the mortgage is compounded (e.g., monthly = 12, annual = 1).
 - **Rate.** This is the nominal rate or the pay rate charged on the mortgage.
 - **Principal (aka PV).** This is the face amount of the initial loan used to establish the periodic payment schedule.
 - **Ec.** The Equity Constant or equity return requirement for the equity investor. This is a simple rate of return which ignores the Time Value of Money (TVM) as well as return provided by amortization or equity buildup and appreciation. It should be noted that the Ec should be expressed to the same periodicity as the mortgage before they are combined into a composite return.
 - **Revenue Units.** This concept is used to convert the absolute square footage of a building to the quantity of units for which rent can be charged in the market.
 - **Net Rentable.** This figure is the total rentable space after allowance for common areas, corridors, elevators, utility rooms, stacks and other non-rentable areas.
 - **Load Factor (aka efficiency ratio).** This is the ratio of the Net Rentable to Gross building area.
 - **Gross Building Area.** This is the total building area. It is typically measured from the inside of the outside walls, although in some cases may extend to the outside surface.
 - **Rental Structure.** This is a scale which indicates the relative levels of rent for various types or classes of space delineated by such criteria as floor, window or view.
 - **Revenue Units.** This is the actual quantity of rent generating space by type of space or overall.
 - **Base Revenue Units.** This figure represents the conversion of Revenue Units into a common denominator which adjusts for the differential rental structure across rental categories.

- **Frontdoor Model Terminology.**
 - **TRCm** (aka Value). This acronym stands for the Total Replacement Cost in the market necessary to produce the asset. It includes the fully loaded costs or all-in costs generated in Case 2: TRCm.
 - **Wcc** (aka Rate). This is the required rate of return for a project given its capital structure (i.e., ratio of debt to equity) and risk profile which affects hurdle rates or return requirements of the respective capital contributors.
 - **NIr** (aka Income). This is the Net Income required for a project to
- **Backdoor Model Terminology.**
 - **GIm**. This is the Gross Income that can be expected from the targeted market. It represents the effective demand; the rate the market is willing and able to pay.
 - **NIm** (aka Income). This is the Net Income anticipated from the target market after application of the Net Income Ratio which represents the leakage or costs associated with operating the property that eat into Gross Income.
 - **RcR**. This is the Real Estate Capture Ratio which stands for the percent of income generated by the targeted market that can be expected to be allocated for total real estate costs. For a household, it is 28% before insurance and taxes and 33% after such real estate-related expenses. For retailers, it is also known as the Total Occupancy Cost Ratio which is generally 12-14% of sales at the particular unit. Similar ratios can be extracted for other property types.
 - **TRCj** (aka Value). This is the Total Replacement Cost Justified by the income earning potential of the project discounted at the appropriate rate of return which is the Weighted Cost of Capital (Wcc).

Case 3 (A): Frontdoor Gross Income Required (GIr)

Exhibit 2 presents a graphical representation of the Frontdoor Model. As noted, the model begins from the left, and proceeds to the right. The dependent variable in this analysis is the Gross Income required (GIr).

Exhibit 2: Frontdoor Model



Step 1: TRCm. The first step in applying the Frontdoor Model is to establish the Total Replacement Cost in the Market (TRCm) necessary to construct the project. This cost can be extracted from the output generated by ui Case 2: TRCm and fed into the Frontdoor Model.

Exhibit 3: TRCm

Component	Item	Cost	Subtotal
Hard Costs	Land Costs	\$ 435,600	
	Construction Costs	\$ 2,440,468	
	Subtotal		\$ 2,876,068
Soft Costs	Known Soft Costs	\$ 139,509	
	Const-Related Fees	\$ 541,784	
	Financing Fees	\$ 314,807	
	Subtotal		\$ 996,100
	Total Replacement Cost (TRCm)		\$ 3,872,167

Step 2: Wcc Overview. Once the TRCm has been specified, the analyst must calculate the Weighted Cost of Capital or blended Rate that must be returned to capital providers. Once the Wcc has been derived, it can be multiplied by the TRCm to establish the Net Income required (NIr). This NIr will provide the respective capital providers with their annuitized return requirements on their relative contributions to the cost of development or acquisition.

- **Mc.** The first step in calculating the Weighted Cost of Capital (Wcc) is to calculate the Mortgage Coefficient (Mc). The Mc is the fixed mortgage payment necessary to amortize \$1. In this case, the Mc is the fixed payment that provides a return on (interest) and a return of (amortization) the initial mortgage. The Mc can be derived through several methods ranging from the mathematical expression, to the application of a business analyst or financial calculator, or through use of financial functions in Excel or some other advanced spreadsheet program. At this point, the analyst should use whichever technique is the most convenient, although it will be useful to be able to apply the other techniques.

- **Mathematical Equation**

$$Mc = PV * [i / ((1 - (1 / (1 + i)^t)))]$$

Where:

- Mc = Mortgage Coefficient
- PV = 1; \$1 is used since the calculation is intended to establish the payment necessary to amortize \$1.
- i = Stated Interest Rate on the mortgage expressed in terms of periodicity (e.g., monthly).
- t = Number of compounding periods considering term and periodicity.

○ **HP 10BII Detailed**

- First, clear all by pressing the GOLD key and then the C ALL key.
- Second, tell the HP that you want to work monthly by entering 12 and then pressing the GOLD key followed by the P/YR.
- Third, enter 30 press the GOLD key, and then press X P/YR.
- Fourth, enter 7.5, press the GOLD key, and then press NOM%.
- Fifth, enter 1 and then press PV.
- Sixth, press PMT to get answer.

○ **Excel.** There are two ways to calculate the Mc in Excel.

▪ **Method 1. Equation**

Mc	=PMT(7.5%/12,30*12,-1)
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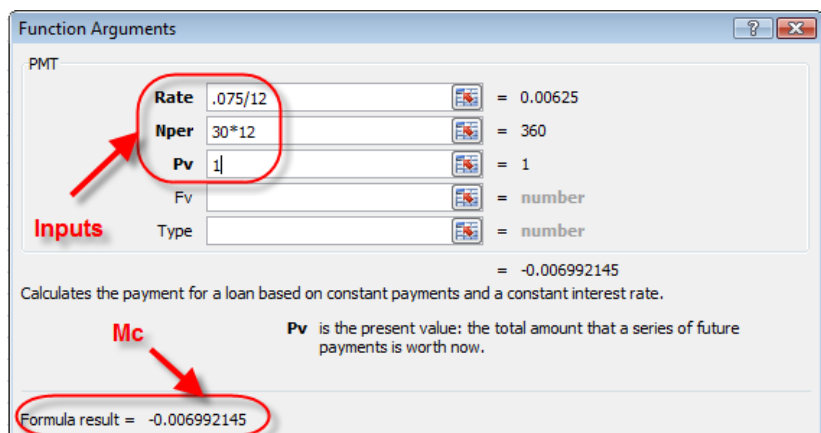
- **Method 2: Financial Function.** In Excel, it is possible to obtain “prompts” to the inputs by activating the PMT function.

PMT(rate,nper,pv,fv,type)

Calculates the payment for a loan based on constant payments and a constant interest rate.

Once the PMT function is activated, the following argument is presented as noted in the Exhibit 4: PMT Function.

Exhibit 4: PMT Function



- Equity Constant (Ec).** The Equity Constant is the stabilized return required by the equity investor. It is analogous to the Cap Rate or the overall rate of return that capitalizes or converts Income to Value. It should be noted that it is important to convert the Ec to the same periodicity (i.e., number of compounding periods per year) as the Mc so they can be combined into an aggregate Wcc. It should also be noted that the Equity Constant does not adjust for return “of” the investment, but merely a return on the investment. However, if the project is priced off of the Ec, due to the benefits of depreciation, interest deductions, equity build-up or amortization, and appreciation.

Once the Mc and Ec are determined, the Wcc can be calculated. As noted in Exhibit 5, the Wcc is the aggregate return measure obtained by weighting the two sources of capital by the Loan-to-Value (LV). In most projects, capital comes from one of these two sources, although there may be more than one player or participant on either the mortgage or equity side of the transaction. In this case, the left side of the equation represents the marginal contribution to the Wcc provided by the mortgagee (i.e., .00559372) while the right side represents the marginal contribution provided by the equity investor (i.e., .0017).

Exhibit 5: Wcc

Wcc	=	[(	LV	*	Mc	)+	((	1	-	LV	)*	(	Ec	/	12)]
		[(	80%	*	0.00699215	)+	((	1	-	80%	)*	(	10%	/	12)]
					0.00559372	+							0.0017			
					0.00726038											

Step 3: Net Income Ratio (NIR). Once the Wcc is established, then the Net Income Ratio (NIR) that represents the operating expenses and allowances must be derived. The operating expense ratios will generally come from the market and will differ by property type, class and market conditions. The Vacancy Rate is an allowance; it may not actually occur if the project outperforms the assumptions creating a higher return to equity.

Exhibit 6: NIR

NIR	=	1	-	(	VacR	+	PTxR	+	ExpR	+	ResR)	
		(1	-	(10%	+	8%	+	8%	+	2%)
												72%	

Step 3: GIr. Once the TRCm and Wcc are determined, the Net Income required (NIr) to provide the required returns by the capital contributors of the total cost of the project (TRCm) can be established by multiplying the TRCm by the Wcc. This calculation is represented in the numerator of the equation presented in Exhibit 7.

Exhibit 7: Gross Income Required (GI_r)

$GI_r = \frac{(TRC_m * W_{cc})}{NIR}$
$= \frac{\$ 3,872,167 * 0.00726}{72\%}$
$= \$ 39,046 \text{ GI per month}$

Step 4: Rental Structure. After the aggregate Gross Income required (GI_r) is determined, the rental structure can be established. This step is designed to calculate differential rents for the respective floors or rental categories to reflect the relative “value” of each of the categories. As noted in Exhibit 8, to calculate the rental structure, we have introduced the notion of Base Revenue Units (BRU). In essence, BRUs represent an adjustment of the number of units by their relative rents to convert the actual revenue units to a common denominator.

Exhibit 8: Annual GI_r and Average GI_r

Gross Income required (GI _r)	\$ 39,046	GI per month
Convert to Annual GI/Yr	x 12 mo.	
GI/yr	\$ 468,557	
Gross square Footage (sf)	18,837	
Average GI _r /sf/yr.	\$ 24.87	

As noted in Exhibit 8, if the entire building is rentable, and if all tenants pay the same rent, the average rent/square foot/year is \$24.87. While the analysis could stop here, some adjustments should be made to ensure the rents are fair in terms of “value add” of the respective spaces, and the average rent is adjusted for the leakage or non-rentable areas. While the rental structure adjustment is optional, the adjustment for the non-rentable area is necessary or the project will not provide the GI_r.

Exhibit 9: Rental Footprint

Exhibit 9 indicates how the rental footprint or floor plate is calculated. As noted, the first step is to net out the non-rentable square footage that is used for common areas and other non-revenue generating space. Once the net rentable is calculated for the building as a whole is calculated, the rentable footprint per floor can be established.

Gross Building SF	18,837
Load Factor	85%
Net Rentable	16,011
# Floors	4
Rentable Footprint	4,003

The final calculations in determining the rental structure can be broken into several stages.

- **Rental % Structure.** The first step is to specify the relative rents of the various components as a percent of the average market rent for comparable properties. In this case, we are expressing the differential rents per floor as a percent of the Base Revenue Unit (BRU) which is generally the “market rent” average. As noted in the Rent@% of BRU, the upper floor rents at a 30% premium, while the first floor rents at a 10% premium over the average market rent. It should be pointed out that the analysis does not depend on which revenue unit category is identified as the BRU, as long as the others can be expressed as a percent of that amount.
- **BRU Equivalents.** By multiplying the rentable SF/Floor by the Rental Structure, the number of Factored (or BRU equivalent) Units can be calculated. For example, the 4,003 sf in the top floor convert to 5,204 sf BRUs (i.e., 4,003 * 130%). Since the middle floors have been identified as the BRUs, the two floors contribute 8,006 BRUs. Finally, the first floor rents at 110% of the BRU, translating to 4,403 BRU equivalents. Thus, the 16,011 net rentable square feet convert to 17,612 BRU equivalents. By applying these percentages to the non-BRUs, the aggregate BRU equivalents can be calculated.
- **Rental Structure.** By dividing the required GIr by the number of BRUs, the Rent/BRU can be calculated. In this case, the BRU Rent is \$26.60/sf. Given this BRU rent, the rental structure can be constructed by multiplying the BRU rent by the Rental % Structure as noted in Exhibit 10. As noted, assuming the top floor rents for \$24.59/sf, the middle floors rent for \$26.60/sf, and the bottom floor rents for \$29.26/sf, the project will generate the required annual income.

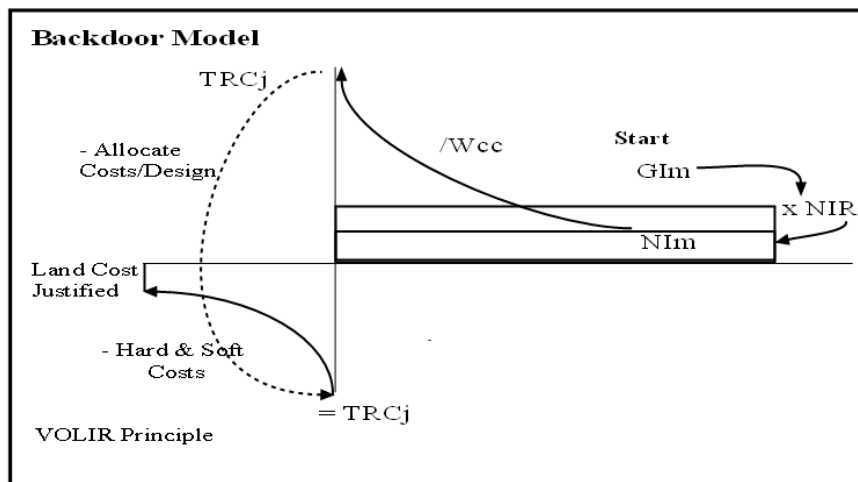
Exhibit 10: Rental Structure

Type of Floors by Rental Level	#Floors/Type	Tot SF/Floor Type	Rent @% BRU	Factored BRU's	Rental Structure	Total Rent
Top Floor (s)	1	4,003	130%	5,204	\$34.59	\$138,437
Middle Floor (s)	2	8,006	100%	8,006	\$26.60	\$212,980
Bottom Floor(s)	1	4,003	110%	4,403	\$29.26	\$117,139
# Factored BRU's				17,612		\$468,557
				Rent/BRU =	\$26.60	

Case 3 (B): Backdoor Analysis of Total Replacement Cost Justified (TRCj)

In some respects, the Frontdoor Model reflects the “Field of Dreams” approach to real estate development; build it and they will come. While a lot of real estate is developed under this model, it is both inefficient and can result in the construction of projects for which there is no “effective demand.” In this context, effective demand is the will and ability to pay for the finished project. The Backdoor Model addresses the “affordability” issue head-on, starting with the likely revenue the project can generate from the targeted market, and then backing into the Total Replacement Cost for which that income can satisfy the return requirements of the respective sources of capital. As noted in Exhibit 11, the Backdoor Model works from the right to the left, with the TRC as the dependent variable. In essence, the calculated figure is the Total Replacement Cost justified (TRCj) by the income-generating potential for the project.

Exhibit 11: Backdoor Model



In order to establish the Gross Income in the market that the project will likely support, the analyst must either extract likely rents from comparable projects, or back into the figure by identifying the most likely users or tenants for the property. This phase involves an iterative process in which the amenity package is first quantified in terms of the static, environmental and linkages dimensions it or the proposed development would afford. Based on this profile, the most likely tenants or space users can be identified by trying to match that amenity package with the users for whom it represents the “best fit.”

Once the most likely space users are identified, the analyst can either look at what they are paying for comparable properties, or apply their Real Estate Capture Ratio (RcR) to their respective income levels. As noted earlier, the RcR indicates the percent of income generated by the targeted market that can be expected to be allocated for total real estate costs. In this case, assume that the rent in the market and the “affordable” rent for the target users are around \$15/sf. On the surface, the gap between the affordable rent of \$20/sf and the required rent of

\$26.60 suggests that the development would not be economically feasible. However, that conclusion would be premature, since the gap between actual and required income may be closed by reducing TRCm, by increasing the NIR, by increasing GI, or by some hybrid combination of these variables.

Step 1: GIm. The first step in the Backdoor Model is to estimate the Gross Income the Market (GIm) will likely pay for the proposed development or acquisition. As noted, the 16,001 net rentable square feet of the project is likely to generate \$320,225 per year at the \$20/sf rate.

Exhibit 12: Net Rentable Space and GIm/sf/yr

Gross Building sf	18,837
Load Factor	85%
Net Rentable	16,011
# Floors	4
Bldg Footprint	4,003
GIm/SF/Yr	\$ 20.00
GIm/Year	\$ 320,225

Step 2: Calculate Rental Structure and GIm/month. While the \$20/sf rate is useful for determining the relative appeal of a property and its likely income generating potential, the figure can be increased by applying the Rental Structure analysis to the average market rent. As noted in Exhibit 13, the \$20 average market rental translates to a value-based rental structure of \$26/sf for the top floor which is 130% of the base, and \$22/sf for the first floor. By adding this precision to the analysis, the expected income can be increased from \$320,225 to \$352,247. This annual revenue translates to \$29,354/month.

Exhibit 13: Rental Structure and GIm

Type of Floors by Rental Level	#Floors/Type	Tot SF/Floor Type	Rent @% BRU	*	Rent; Structure	Rent/Floor Type
Top Floor (s)	1	4,003	130%		\$ 26.00	\$ 104,073
Middle Floor (s)	2	8,006	100%		\$ 20.00	\$ 160,112
Bottom Floor(s)	1	4,003	110%		\$ 22.00	\$ 88,062
Total Rent/SF/yr.						\$ 352,247
					Gross Income/mo.	\$ 29,354

Step 3: Net Income Market (NIm). After the GIm has been calculated, the NIm can be derived by applying the Net Income Ratio (NIR) to the gross income to account for operating expenses and other costs that have a prior claim on income before capital providers (i.e., debt and equity). Exhibit 14 presents the calculation of the Net Income Ratio (NIR) that expresses the Net Income as a percent of the Gross Income the project is likely to generate. As noted in the exhibit, the NIR is 72%, with the leakage coming from the vacancy allowance, the property tax estimate, the operating expense ratio, and the reserve ratio. As noted in the Frontdoor Model, the operating expense ratios will generally come from the market and will differ by

property type, class and market conditions. On a similar note, the Vacancy Rate is an allowance; it may not actually occur if the project outperforms the assumptions creating a higher return to equity.

Exhibit 14: NIR

NIR	=	1	- (	VacR	+	PTxR	+	ExpR	+	ResR)	
	=	(1	- (10%	+	8%	+	8%	+	2%)
	=										72%	

Step 4: Weighted Cost of Capital (Wcc). Once the NIm has been determined, the TRCj can be calculated by capitalizing the Net Income (NIm) by the Weighted Cost of Capital (Wcc). In a reverse manner from the Frontdoor Model, the NIm is divided by the Wcc to establish the TRCj or value of the Net Income the project is likely to generate.

- **Mc.** The first step in calculating the Weighted Cost of Capital (Wcc) is to calculate the Mortgage Coefficient (Mc). The Mc is the fixed mortgage payment necessary to amortize \$1. In this case, the Mc is the fixed payment that provides a return on (interest) and a return of (amortization) the initial mortgage. The Mc can be derived through several methods ranging from the mathematical expression, to the application of a business analyst or financial calculator, or through use of financial functions in Excel or some other advanced spreadsheet program.

- There are two ways to calculate the Mc in Excel.

- **Method 1. Equation**

Mc	=PMT(7.5%/12,30*12,-1)
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- **Method 2: Financial Function.** In Excel, it is possible to obtain “prompts” to the inputs by activating the PMT function.

PMT(rate,nper,pv,fv,type)
 Calculates the payment for a loan based on constant payments and a constant interest rate.

- **Equity Constant (Ec).** The Equity Constant is the stabilized return required by the equity investor. It is analogous to the Cap Rate or the overall rate of return that capitalizes or converts Income to Value. It should be noted that it is important to convert the Ec to the same periodicity (i.e., number of compounding periods per year) as the Mc so they can be combined into an aggregate Wcc. It should also be noted that

that the Equity Constant does not adjust for return “of” the investment, but merely a return on the investment. However, if the project is priced off of the E_c , due to the benefits of depreciation, interest deductions, equity build-up or amortization, and appreciation.

Once the M_c and E_c are determined, the W_{cc} can be calculated. As noted in Exhibit 5, the W_{cc} is the aggregate return measure obtained by weighting the two sources of capital by the Loan-to-Value (LV). In most projects, capital comes from one of these two sources, although there may be more than one player or participant on either the mortgage or equity side of the transaction. In this case, the left side of the equation represents the marginal contribution to the W_{cc} provided by the mortgagee (i.e., .00559372) while the right side represents the marginal contribution provided by the equity investor (i.e., .0017).

Exhibit 15: W_{cc}

W_{cc}	=	[(	LV	*	M_c	)+	((	1	-	LV	)*	(	E_c	/	12)]
	=	[(	80%	*	0.00699215	)+	((	1	-	80%	)*	(	10%	/	12)]
	=				0.00559372	+							0.0017			
	=				0.00726038											

Step 5: Calculation of TRC_j . At this point, the Total Replacement Cost justified by the N_{Im} and the W_{cc} can be calculated as noted in Exhibit 16. In essence, the N_{Im} (i.e., $G_{Im} * NIR$) is capitalized by, or divided by, the W_{cc} to establish the TRC_j .

Exhibit 16: TRC_j

TRC_j	=	$\frac{G_{Im} * NIR}{W_{cc}}$
TRC_j	=	$\frac{\$ 29,354 * 72\%}{0.00726038}$
TRC_j	=	\$2,910,982 TRC_j

Case 3 (C): Rationalizing Frontdoor/Backdoor Divergence

At this point, the analyst can calculate the gap between the G_{Ir} necessary to support the Frontdoor analysis and the TRC_j by the G_{Im} that the targeted market can be expected to generate. This analysis can include a number of iterations. Ultimately, the numbers must

converge or the project is not likely to satisfy the goals and objectives of the capital providers, cover anticipated expenses, and provide adequate funding to develop the proposed project.

Exhibit 17: Divergence Between the Frontdoor and Backdoor Analysis

Approach	TRC	Rent/sf
Frontdoor Budget	\$ 3,872,167	\$26.60
Backdoor Justified	\$2,910,982	\$20.00
Gap to Rationalize	33.0%	33.0%

As noted in Exhibit 17, there are significant differences between the Frontdoor and Backdoor models, suggesting the project needs a combination of cost-cutting or rental increases to make it pencil out. If the numbers cannot be made to converge within tolerable variances (say up to 5%), the project is not likely to be economically viable and financially feasible.