Current readings

- Denise DiPasquale and William C. Wheaton, *Real Estate Economics*, Chapter 1, The Property and Capital Markets.
- Bertrand Renaud, The Real Estate Economy and the Design of Russian Reforms. (In two parts). *Urban Studies*, 1995. Required, Part II. Part I is recommended.
- Note: the 4QM is also discussed in Geltner and Miller, *Commercial Real Estate Analysis and Investments*, Chapter 2. Recommended.

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You may have seen "a" four quadrant model of real estate before, in real estate finance:

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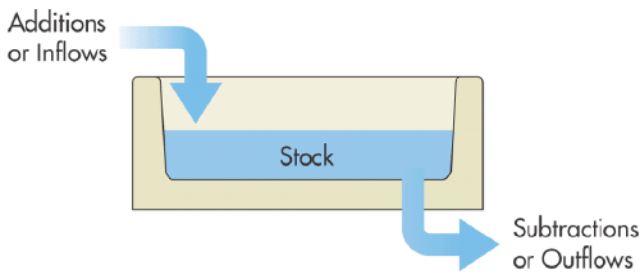
The "Four Quadrants" of RE Investment

	Public	Private
Debt	Mortgage REITs; MBS and other structured debt	Whole mortgages
Equity	Equity REITs; Listed property companies	Direct property investments; Private equity funds; Private REITs

This is a very useful taxonomy, but it is NOT the 4QM we'll be using in Urban Economics!

An Analytic Framework

- Now we will focus on the four quadrant model of DiPasquale and Wheaton.
  - Don't confuse with the broadly similar model by Jeff Fisher, e.g. in Brueggeman and Fisher.
    - Conceptually similar, but different.
  - Don't confuse with the four quadrants of real estate investment (public/private, by debt/equity).
    - See previous slide.
    - Nothing in common but the jargon.



A Fundamental Concept: Stocks and Flows

- Flows: Amounts per period yielded by an asset.
- Stocks: Corresponding total value of an asset at a particular time.

Income, GDP	⇒	Wealth
Dividends	⇒	Stock Price
Rent	⇒	Property Value

The 4QM is a stock-flow model. Considers both.

Figure 1 Demand for Stock of RE

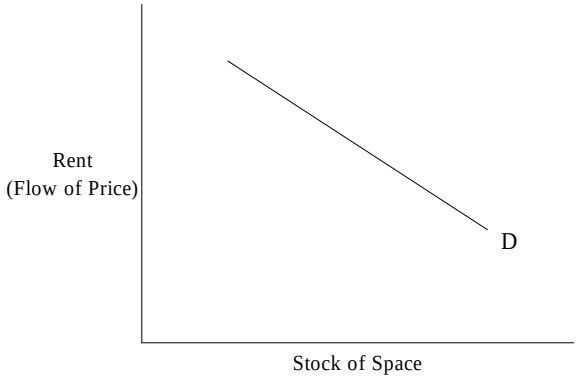


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Figure 2 Annual Construction in the Steady State

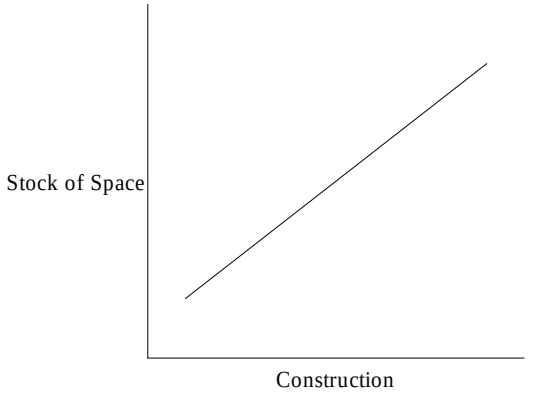

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Figure 3 Supply of New Construction

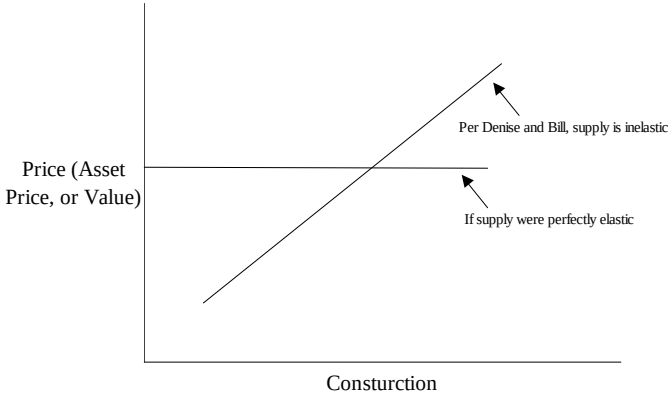

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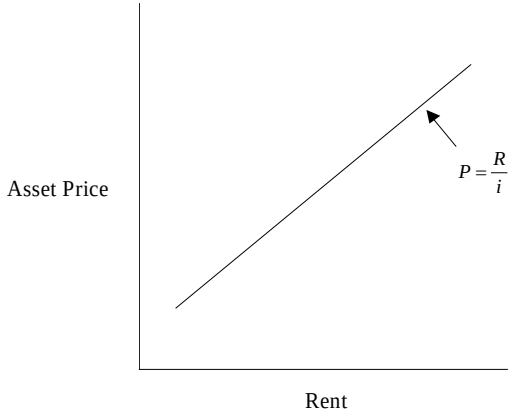
Figure 4 Asset Price is Present Values of Rents



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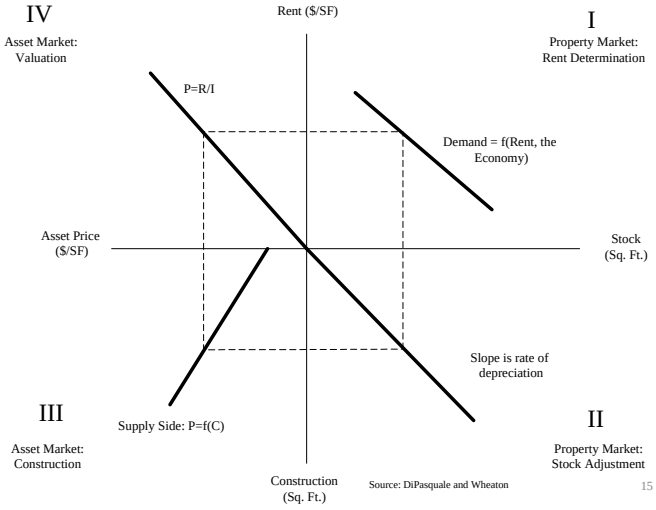
Markets for the Use of Property, and Asset Markets



Source: DiPasquale and Wheaton

Some Insights of the 4 Quadrant Model

- Integrates stocks and flows in a simple framework
- Comparative static model; not a true dynamic model
- Easy to "solve" graphically for *qualitative* changes
- It's a little tricky to solve for actual numbers because the four equations are *simultaneous*.
  - Well, not too tricky. Four equations, four unknowns.
  - Spreadsheet model can do some of the work for us, using Excel's *Solver* add-in.

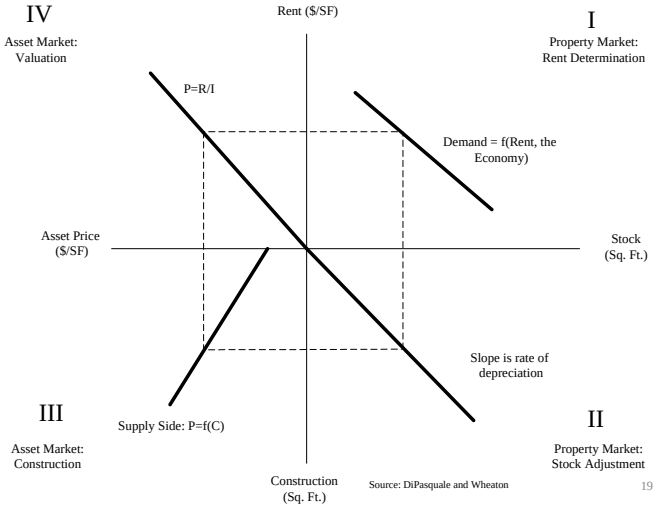
Analysis with the 4QM

- Demand for real estate by foreign investors increases.
  - 4QM → cap rates fall (QIV). Asset prices rise.
  - But supply response (QIII) increases stock of space, rents fall (QI), moderating original asset price increase.
- Demand for real estate increases from the office sector.
  - 4QM → Demand shifts out (QI), values rise. Note difference between shifts in space demand and asset demand!

Further Analysis with the 4QM

- Mortgage rates fall.
  - 4QM → When long term rates fall, then existing yield from real estate becomes higher in relative terms. Investment demand increases. Cap rates fall (QIV), supply up (QIII), rents fall (QI).
- Short term interest rates fall.
  - 4QM → Higher short term rates (holding long term rates constant) shift the costs of development (QIII), lowers the stock of space (QII), rents rise (QI), asset prices rise with costs (QIV).
- Many other scenarios possible, e.g. an increase in public housing, growth management, tax changes.

Markets for the Use of Property, and Asset Markets



Source: DiPasquale and Wheaton

Calibrating the 4QM

- Following a textbook version of DiPasquale and Wheaton (1996, p. 8), we specify the relationships in our 4QM as follows:
- (1) $S = E(400-10R)$
- (2) $C = \delta * S$
- (3) $P = 200 + 5C$
- (4) $R = iP$
- Where do these numbers come from? How can we calibrate the model? We'll discuss briefly now, more on this later.

	A	B	C	D	E	F	G	H
1	**Summary of Denise and Bill's Model (see Ch. 1)**							
2								
3	**Inputs in Red ("Guess" will change after model's run)**					**Model Equations**		
4	**Exogenous Variables**							
5						**Demand for Stock of Space, S**		
6	Employment (Million	**E**	20.00			Sd= E(400-10R)	4000.00	
7	Cap Rate	**i**	0.05					
8	Depreciation Rate	**delta**	0.01			**Flow of Construction (Steady State, C)**		
9						C= delta* S	40.00	
10								
11	**Endogenous Variables**		***Guess***	***Solution***	***Difference***	**Construction Cost (Asset Price), P**		
12	Space (Mil Sq Ft)	**S**	4000.00	4000.00	0.00	P= 200+ 5C	400.00	
13	Construction (Mil Sq	**C**	40.00	40.00	0.00	In equilibrium,, construction cost= asset price, so		
14	Asset Price (Value) (	**P**	400.00	400.00	0.00	eqlbm. level of construction is: C= (P-200)/5		
15	Flow Price (Rent) ($	**R**	20.00	20.00	0.00			
16					"----------	**Rent per sq ft, R**		
17			***Sum of Differences:***		0.00	R= iP (or P= R/i)	20.00	
18								
19	**Notes**							
20	I would prefer to use V for value instead of P for price, but we'll stick with D&B's notation.							
21	Notice if we standardize for quality and location, R is flow price and P is stock price.							
22	Model is in spreadsheet "Four Quadrant RE Market Model.XLS" To run, change exogenous variables							
23	(and equations if necessary), and make initial guess for endogenous variables.							
24	Then run SOLVER in Excel (let sum of differences= 0, subject to each individual							
25	difference also equals zero).							
26	Notice this is the *steady state* solution. If (e.g.) employment increases, solve the							
27	model twice (at old and new values of E). The difference between S on the first run							
28	and S on the second will be the one-time shock to construction, and C in the							
29	second run will be the new steady state (replacement) construction. We call							
30	such an exercise *comparative statics*.							

	A	B	C	D	E	F
1						
2						
3	Inputs in Red ("Guess" will change aft					Model Equati
4	**Exogenous Variables**					
5						**Demand for Stock of Space, S**
6	Employment (Millions)	**E**	20			Sd= E(400-10R)
7	Cap Rate	**i**	0.05			
8	Depreciation Rate	**delta**	0.01			**Flow of Construction (Steady State, C)**
9						C= delta* S
10						
11	**Endogenous Variables**		***Guess***	***Solution***	***Difference***	**Construction Cost (Asset Price), P**
12	Space (Mil Sq Ft)	**S**	3999.99989417	= + G6	= + C12-D12	P= 200+ 5C
13	Construction (Mil Sq Ft)	**C**	39.9999992168	= + G9	= + C13-D13	In equilibrium,, construction cost= asset price, so
14	Asset Price (Value) ($ per SF)	**P**	399.999996084	= + G12	= + C14-D14	eqlbm. level of construction is: C= (P-200)/5
15	Flow Price (Rent) ($ per SF)	**R**	20.0000005291	= + G17	= + C15-D15	
16					"----------	**Rent per sq ft, R**
17			***Sum of Difference***		= SUM(E12:E15)	R= iP (or P= R/i)
18						
19	**Notes**					
20	I would prefer to use V for value instead					
21	Notice if we standardize for quality and l					
22	Model is in spreadsheet "Four Quadrant					
23	(and equations if necessary), and make					
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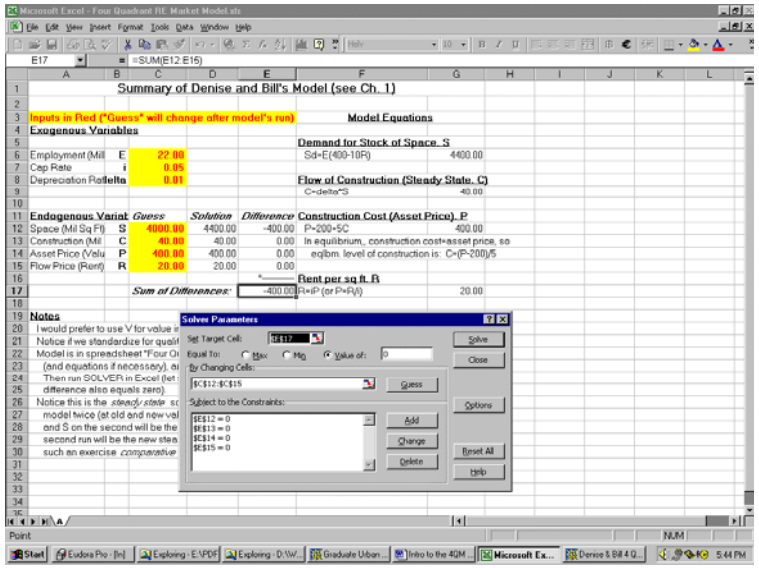


Application of the 4QM to Country Economic Analysis: Russia, 1990s (Transition period)

- From World Bank Sector Report 14929-RU, Chapter 3 (summarized in Renaud, Urban Studies, Part II)
- Stabilization strategy in light of the 4QM:
  - QI: Demand is now "behind a veil." Privatize the housing stock, reform rents, subsidies.
  - QII: Lower depreciation with better incented maintenance, rehabilitation (where feasible).
  - QIII: Improved regulatory framework and "industrial organization" of the real estate market will enhance supply.
  - QIV: Costs of funds must rise to opportunity cost, cap rates will rise, asset prices will fall to a sustainable equilibrium.

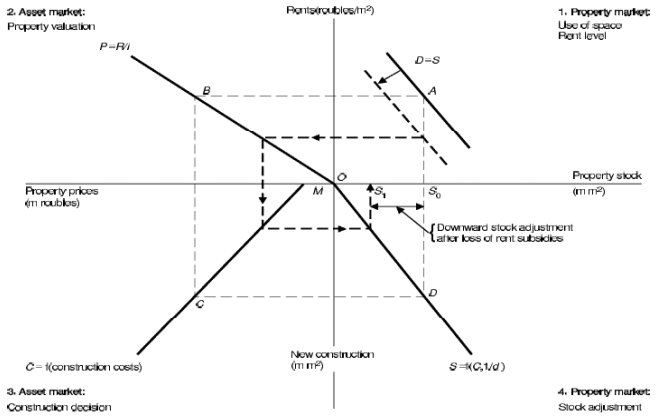


Figure 1. Recent shocks to the traditional housing system.

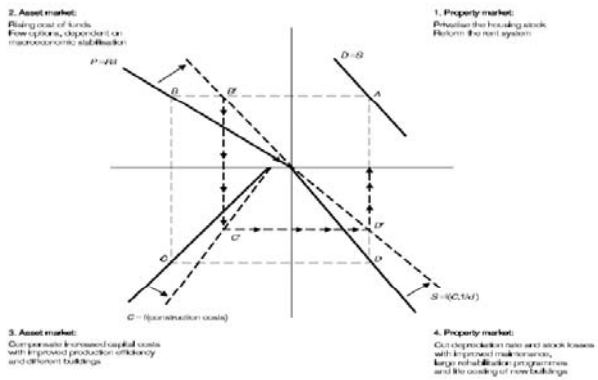
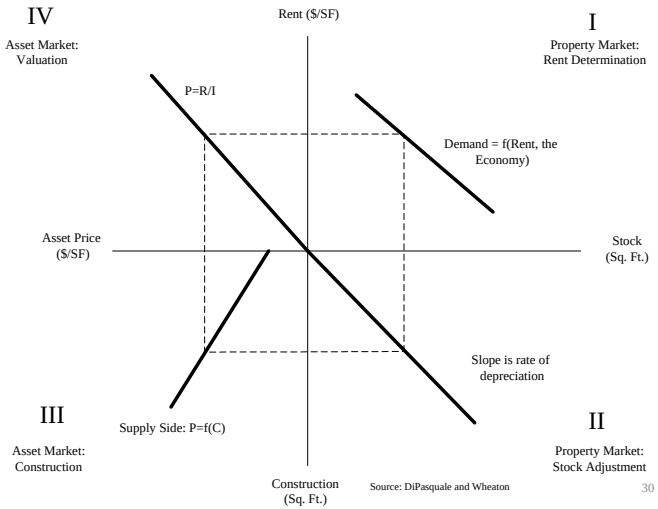


Figure 2. Stabilisation strategy for housing.

The 4QM helps us take a closer look at the market.

Markets for the Use of Property, and Asset Markets

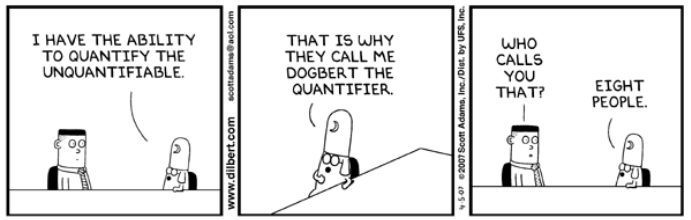


Source: DiPasquale and Wheaton

The 4QM Motivates Market Analysis

- What drives user demand for product? (Q1)
- What affects depreciation? (Q2)
- What determines responsiveness of supply? (Q3)
- What drives investment demand? (Q4)

  – *Can we put numbers on these?*



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- Where do these numbers come from? How can we calibrate the model?

Estimating the relationship in Q1

- What does the demand for space look like? Let's estimate a D-W model (see equation 1, above), using Torto-Wheaton data from 1980 to 1993.
  – See dataset OFFICE.xlsx on course website
- The data are "panel data," i.e. a "stacked" dataset of MSAs over time. We'll used "fixed effects," i.e. add a set of dummy variables for each separate MSA, as well as our variables of interest.
  – (Table will only present variables of interest.)

Here's what the top of OFFICE.xls looks like…

MSANUM	MSA	MSACODE2	DATE	YEAR	SEMESTER	MGROW	EMPLOY	MTCOMPL	STOCK	STCOMPL	ABSORB	VAC	RENT	DRENT
1	ATLANT	520	1967.10	1967.00	1.00	0.0	91.3	211	7424	47	-180	17.9	0.00	0.0
1	ATLANT	520	1967.20	1967.00	2.00	0.0	93.5	633	8057	19	745	15.1	0.00	0.0
1	ATLANT	520	1968.10	1968.00	1.00	0.7	96.3	626	8683	0	644	13.8	0.00	0.0
1	ATLANT	520	1968.20	1968.00	2.00	1.4	98.3	1097	9780	0	1102	12.2	0.00	0.0
1	ATLANT	520	1969.10	1969.00	1.00	6.4	102.2	1444	11224	70	1290	12.0	0.00	0.0
1	ATLANT	520	1969.20	1969.00	2.00	6.9	104.0	1444	12668	208	625	17.1	0.00	0.0
1	ATLANT	520	1970.10	1970.00	1.00	4.4	107.1	957	13625	644	262	21.0	0.00	0.0
1	ATLANT	520	1970.20	1970.00	2.00	2.4	108.0	766	14391	887	1483	14.9	0.00	0.0
1	ATLANT	520	1971.10	1971.00	1.00	-0.3	111.9	1006	15397	351	810	15.2	0.00	0.0
1	ATLANT	520	1971.20	1971.00	2.00	1.2	113.0	836	16233	185	969	13.6	0.00	0.0
1	ATLANT	520	1972.10	1972.00	1.00	3.6	115.9	550	16783	254	962	10.7	0.00	0.0
1	ATLANT	520	1972.20	1972.00	2.00	3.7	116.9	634	17417	108	880	8.9	0.00	0.0
1	ATLANT	520	1973.10	1973.00	1.00	3.5	122.4	834	18251	25	377	11.0	0.00	0.0
1	ATLANT	520	1973.20	1973.00	2.00	3.3	130.2	1620	19871	32	1223	12.1	0.00	0.0

Data are twice a year ("semester" data), which is unusual…

If rent is zero, it's missing

Data are stacked: Atlanta, followed by Baltimore, then Boston…

Table 1: Summary Regression Results, Simple Demand for Office Space

Dependent Variable: Stock of Space, in 1000 Sq Feet

Adjusted R^2	0.99
Degrees of freedom	1233
Employment	
Coefficient	412.79
Standard Error	5.22
t-Statistic	79.1
Prob > |t|	0.0001
Std Coefficient	1.590
Tolerance	0.017
Employment*Rent	
Coefficient	-4.71
Standard Error	0.24
t-Statistic	-19.8
Prob > |t|	0.0001
Std Coefficient	-0.400
Tolerance	0.015

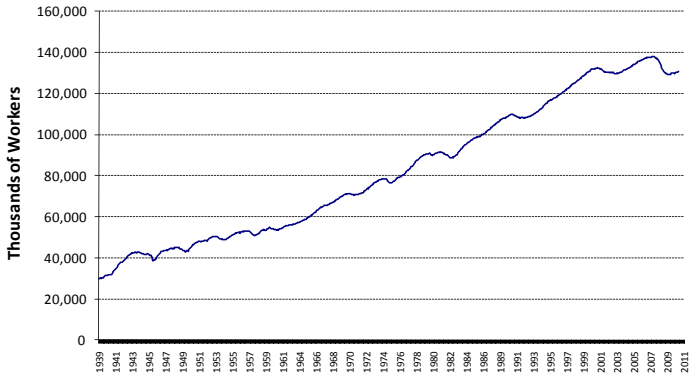
Employment in 1000s, rent in $/sq. ft.
Rent in interaction term is adjusted for inflation.
Model is estimated with fixed effects, e.g. a shift variable for each MSA.

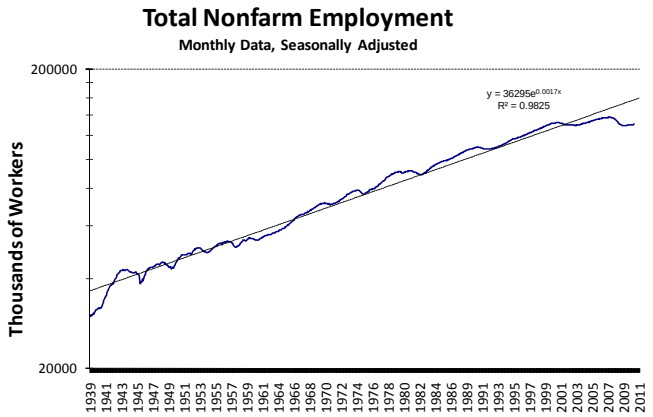
Demand drivers vary by property type

- What are the main Q1 demand drivers for:
  - Office?
  - Apartments?
  - Retail?
  - Hotel?
  - Industrial?
- Employment is a key driver in many markets. What *kind* of employment?

Total Nonfarm Employment

Monthly Data, Seasonally Adjusted





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An alternate look at employment

- Headline employment data are collected and presented monthly. They are net employment.
- Behind net employment: gross employment changes:

  \+ gains from new establishments
  \+ hiring at old establishments
  − losses from plant closures
  − losses from layoffs and firings
  = net employment change

- Since the 1990s, BEA has (separately) collected data on gross job flows as well as the net number.

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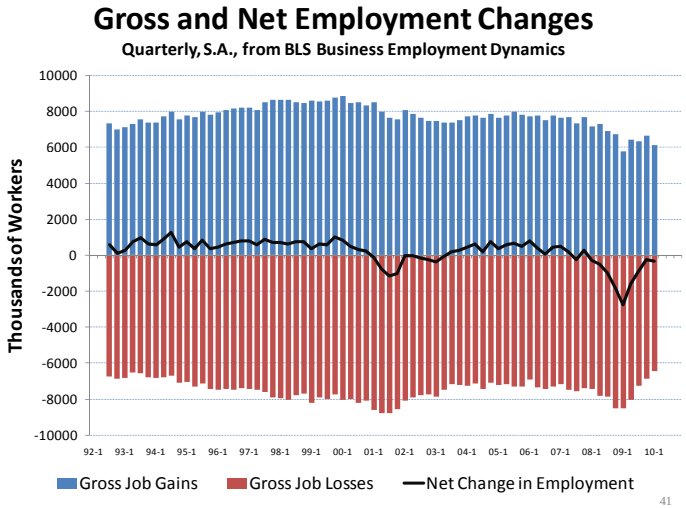

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