Can technical improvement in motor vehicles reduce refined fuels use?

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Objective of the study

Modelling energy intensive services: the case of private transport

- Consumption models treat physical energy as if it was consumed directly by households.
- However, households typically use physical energy in combination with other inputs to 'produce' energy services, such as private transport.

Impact of technical progress

- Technical progress is a major contributor of economic growth, and can deliver reduction in physical energy use.
- Technical progress can happen in both refined fuels and motor vehicles. This study focuses on vehicle augmenting technical progress.

The study

Partial equilibrium

- We develop a simple partial equilibrium model where households 'self produce' private transport using refined fuels and motor vehicles.
- We use a diagram to assess the impact of vehicle saving technical improvement on refined fuels use.

General equilibrium

- We incorporate the partial equilibrium model above into a CGE for the UK.
- We assess the impact of an illustrative technical improvement in motor vehicles use on refined fuels.
- We assess the system wide impact of such technical improvement.

The basic setting

$$\max m = m(v^e, f^e)$$
$$\textit{subject to}$$
$$p_f^n f^n + p_v^n v^n - y \geq 0$$
$$\textit{where}$$
$$z^e = \varepsilon^z z^n \text{ and}$$
$$p_z^e = \frac{p_z^n}{\varepsilon_z} \text{ for } z = (f, v)$$

$m = \textit{motoring}$
$v = \textit{motor vehicles}$
$f = \textit{refined fuels}$
$e = \textit{efficiency units}$
$n = \textit{natural units}$
$\varepsilon = \textit{efficiency parameter}$

Solving

$$\frac{\partial m}{\partial z^n} = p_z^n = \frac{\partial m}{\partial z^e}\varepsilon_z$$

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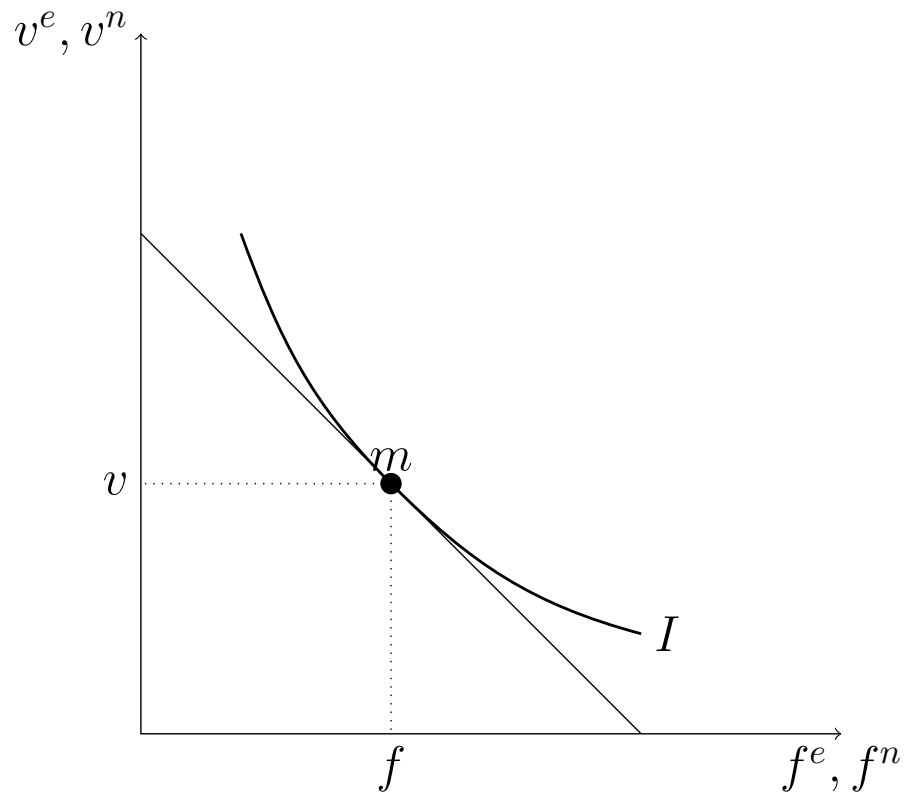


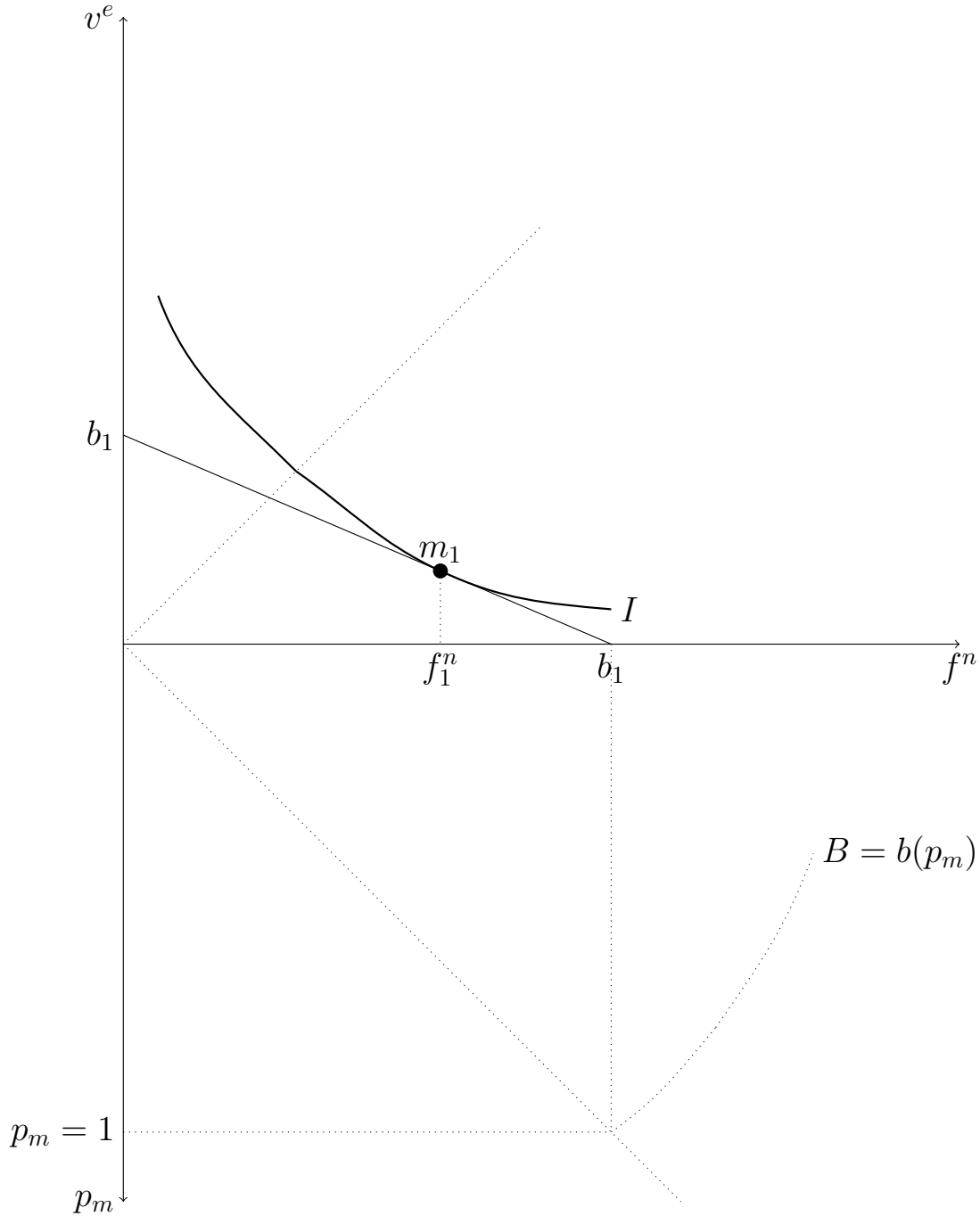
Technical progress

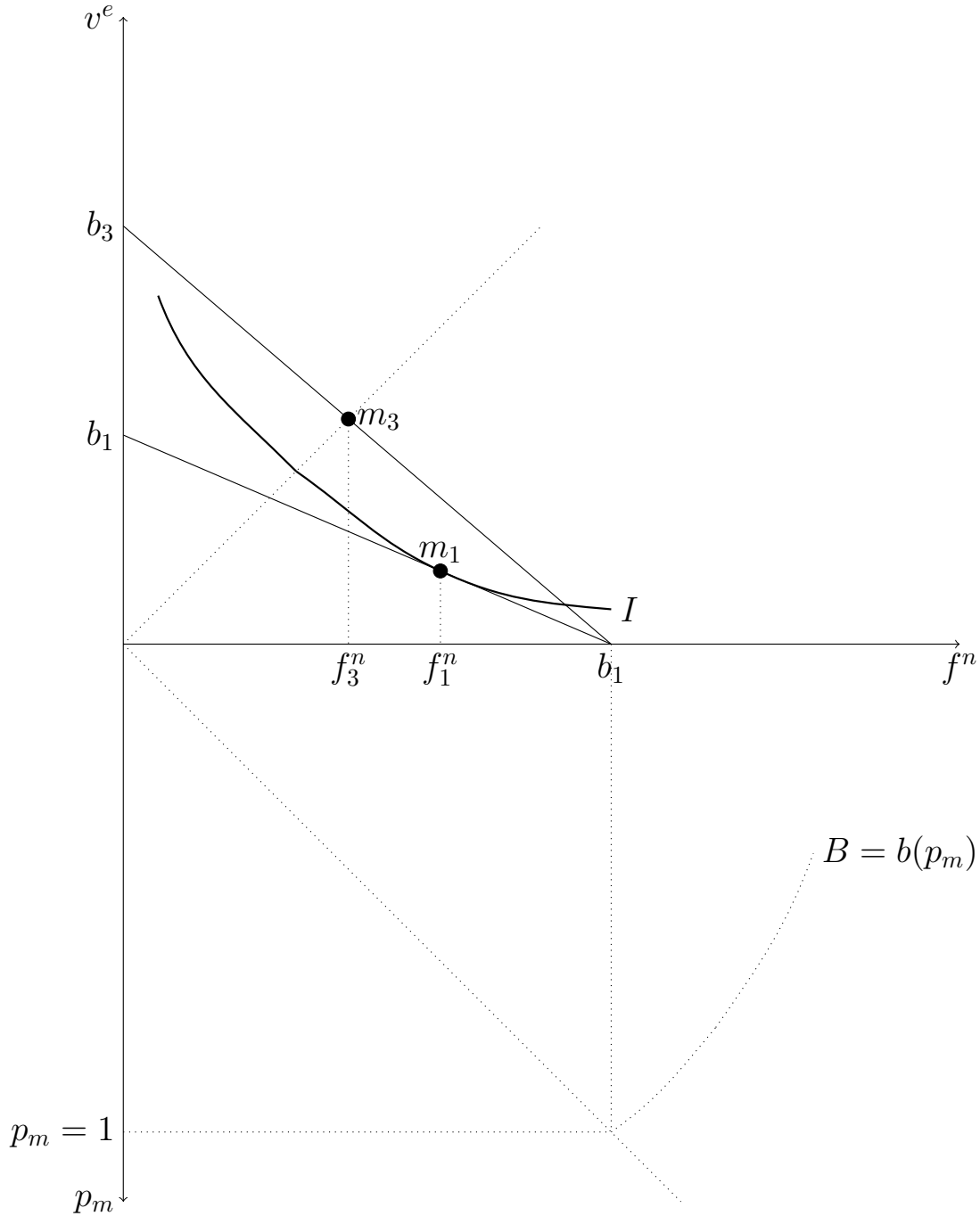
What do we mean by vehicle augmenting technical progress?

A technical change that improves the vehicle's **durability**, thereby reducing **maintenance** and **depreciation** costs, but has no direct impact on fuel efficiency.

How does this impact fuel use?

- impact will depend on the elasticity of substitution between vehicles and fuels $\sigma_{v,f}$
- it will also depend on the elasticity of demand for private transport, or $\sigma_{m,a}$.


v^e
b_1
m_1
I
f_1^n
b_1
f^n
$B = b(p_m)$
$p_m = 1$
p_m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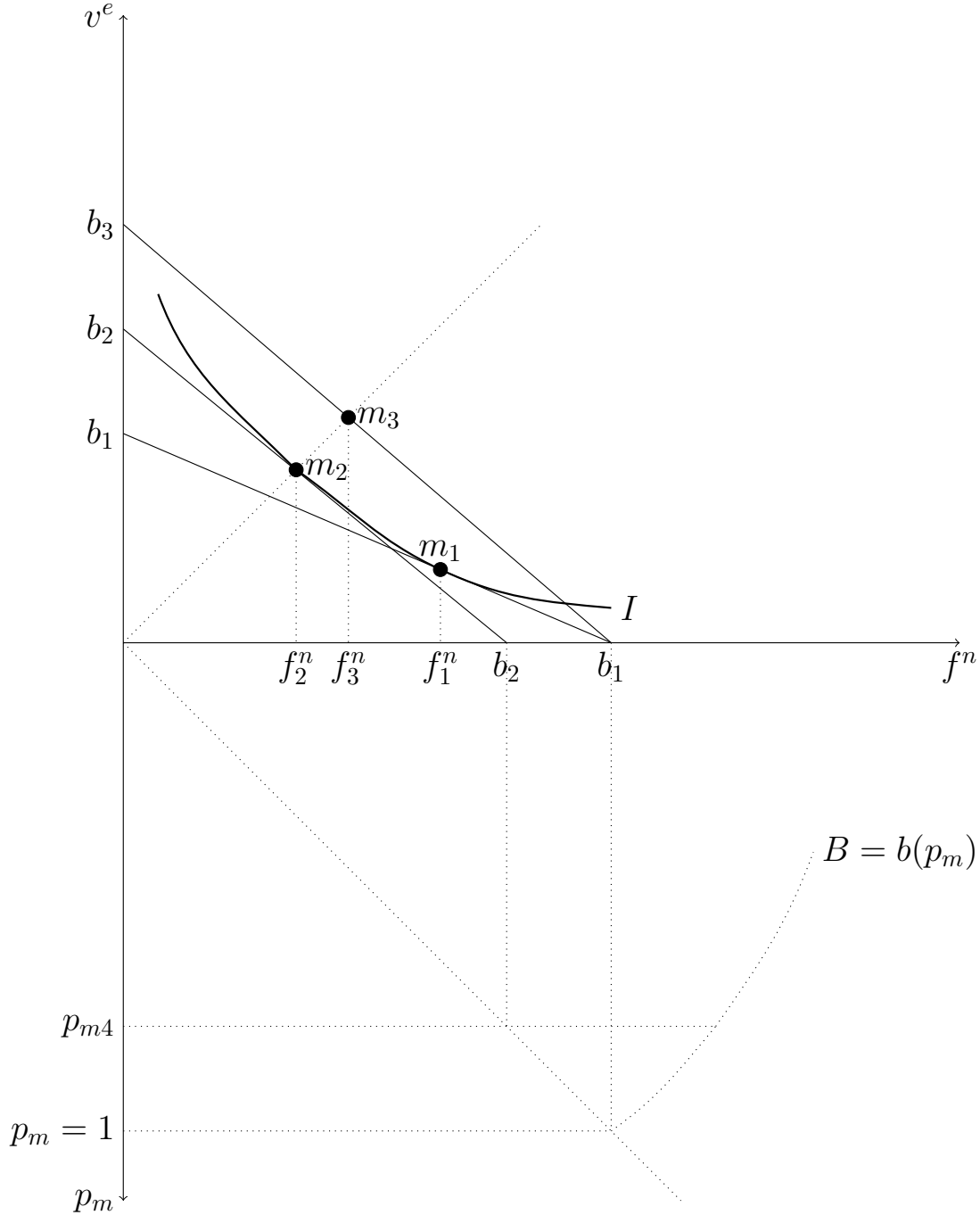
v^e
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f^n
$B = b(p_m)$
p_{m4}
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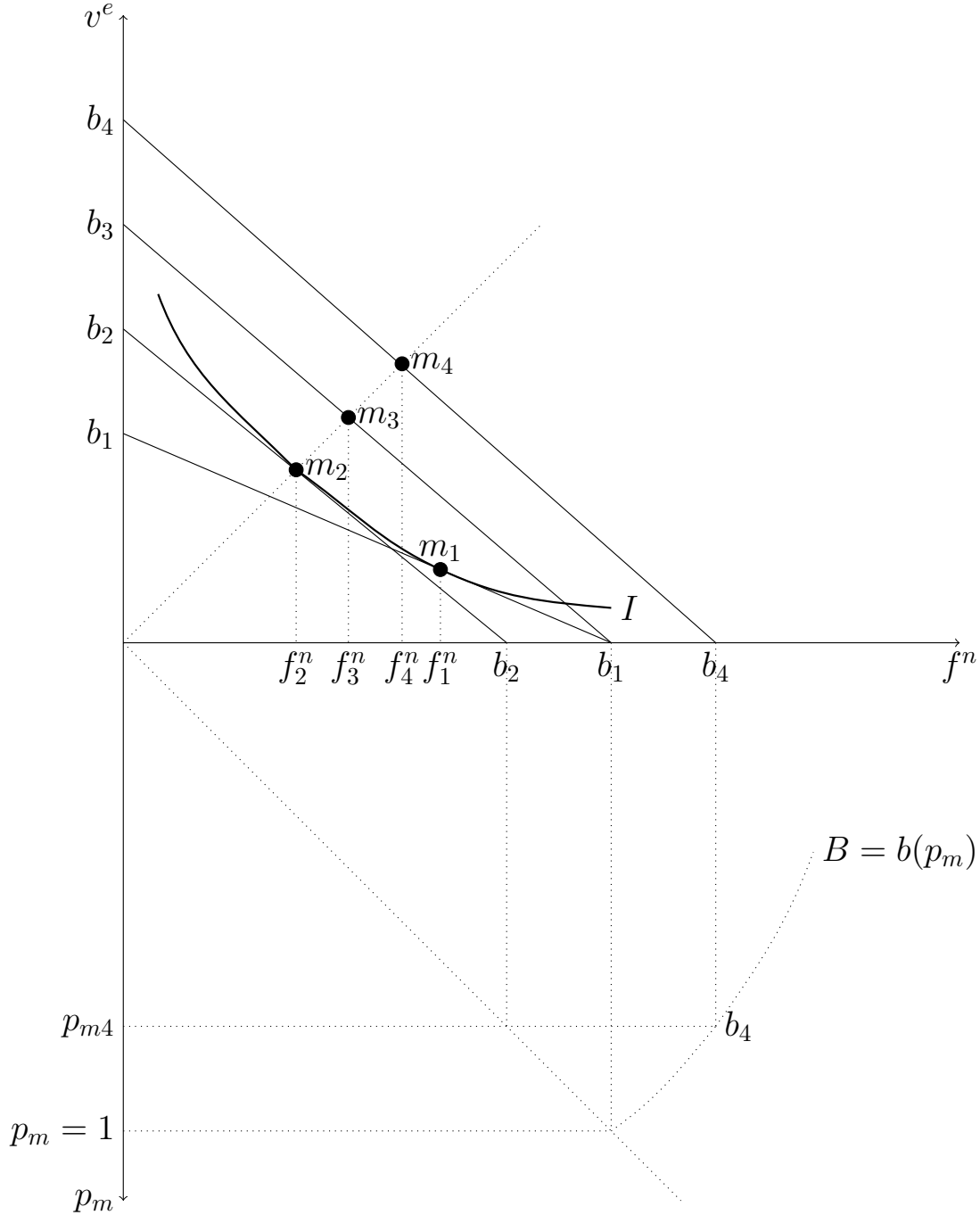
p_m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General equilibrium

Why do we need a general equilibrium approach?

1. Apply the model using data from the real world.
2. Assess the impact of endogenous market prices and nominal income.
3. Assess the system wide impact of technical improvement in motor vehicles.

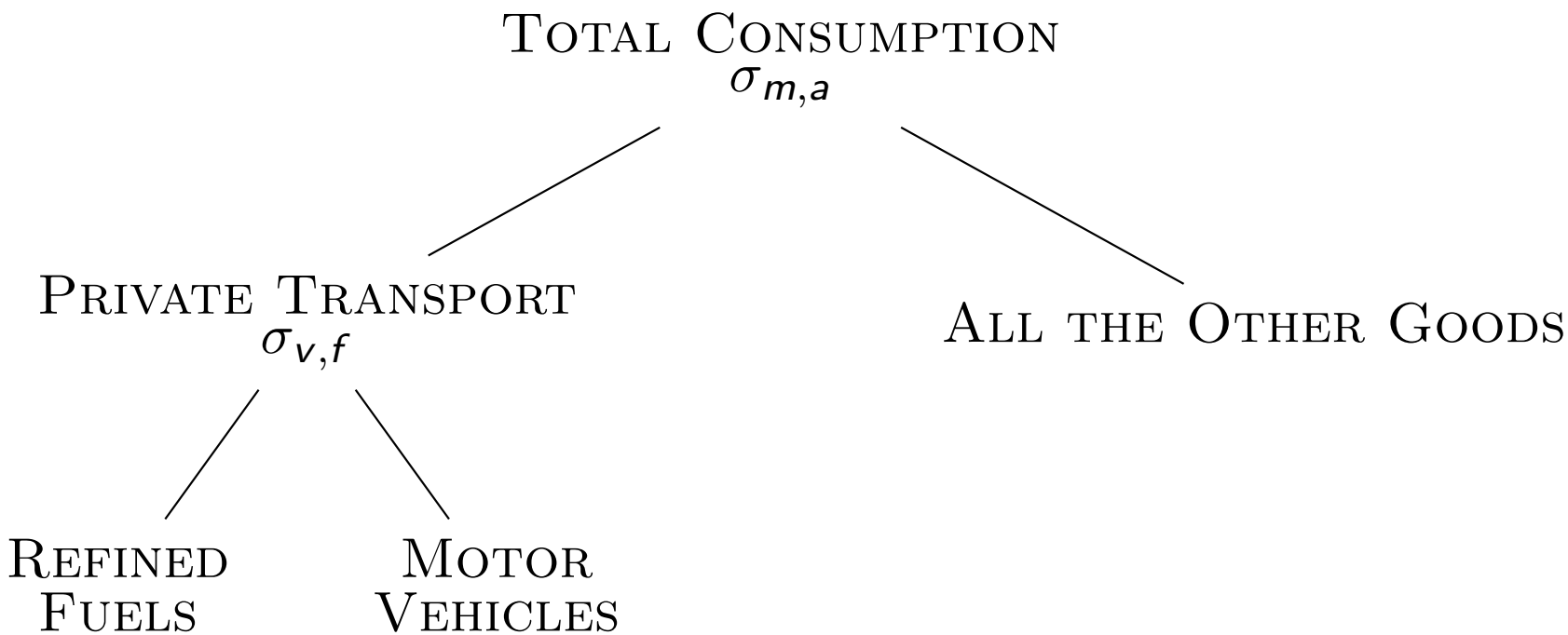
The UK-ENVI CGE model

key features of the UK-ENVI CGE model

- Single region dynamic model, with myopic or forward-looking consumption and investment.
- KLEM production function.
- Capital accumulates via investment.
- Fixed labour supply, with unemployment pool, and different labour marked closures.
- We explore fixed real wage closure and wage curve.
- Consumption is allocated between **private transport** and all **other goods**, and **private transport** is composed of **motor vehicles and refined fuels**.

The structure of consumption

Figure: The structure of consumption



Results central case scenario

Table: **Percentage change from the baseline**

	A	B
ELASTICITIES		
$\sigma_{m,a}$	**1.5**	**0.5**
$\sigma_{v,f}$	**1.2**	**1.2**
PRICES		
Price of fuel	0.00	0.00
Price of vehicles	0.00	0.00
Price of vehicles eff units	**-10.00**	**-10.00**
Price of transport	-3.67	-3.67
HOUSEHOLD CONSUMPTION		
Fuels	1.18	-2.51
Motor vehicles	3.12	-0.64
Private transport	5.82	1.97
All other goods	-0.05	0.04
Vehicles intensity in transport	1.16	1.16
Fuels intensity in transport	-0.75	-0.74
MACROECONOMIC EFFECTS		
GDP	-0.02	0.02
CPI	0.00	0.00
Real wage	—	—
Household consumption	-0.02	0.01
Exports	0.00	0.00

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Conclusions

- Properly modelling energy intensive services is important for the analysis of actions aimed at reducing fuel use.
- Technical progress in the other input to an energy service does influence energy use.
- This technical progress can potentially reduce fuel use and stimulate the economy.
- This modelling framework can capture the implicit price of energy services and use it in the *cpi* calculation.

Thank You for Your Attention

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